THE

JOURNAL OF GAS LIGHTING,

&c., &c.

Vol. LVII.—January to June, 1891.

THE

JOURNAL

OF

GAS LIGHTING,

WATER SUPPLY,

AND

SANITARY IMPROVEMENT.

88078

VOL. LVII.

January to June, 1891.

LONDON:

WALTER KING,

11, BOLT COURT, FLEET STREET, E.C.

THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LVII. No. 1443.] LONDON, JANUARY 6, 1891. [43RD YEAR. Price 6d.

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Guaranteed Free from Adulteration. **TORBAY PAINTS.**

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The Original "Torbay Paints"
As supplied during the present and many preceding years to the LONDON GASLIGHT & COKE COMPANY.

Special Quotations to Gas Companies.

TORBAY & DART PAINT Co., Ld.,
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Works: DARTMOUTH, DEVON.

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PARKER & LESTER,
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THE ONLY MAKERS OF
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Parker's Imperial Black Varnish,
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Ashmore, Benson, Pease, & Co., Ld.,
STOCKTON-ON-TEES,
Manufacturing Gas Engineers.
See Advertisement, Vol. LVI. p. 820.

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Portland Cement
MANUFACTURED BY
GEO. & THOS. EARLE,
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STOREAGE CAPACITY 10,000 Tons.

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Manufacturers & Patentees of every Description of
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FOR
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We specially solicit Government and Local Board Contracts for General Lighting.

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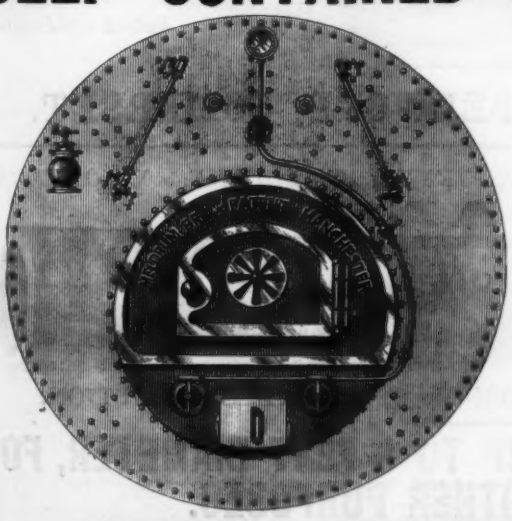

OVER 200 WORKING,

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PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

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EDWARD COCKEY & SONS, Ld.,

ESTABLISHED OVER HALF A CENTURY.

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MANUFACTURERS OF IMPROVED GAS-EXHAUSTING APPARATUS.

A Large Stock of Valves always on hand.

Lamp Columns; various patterns.

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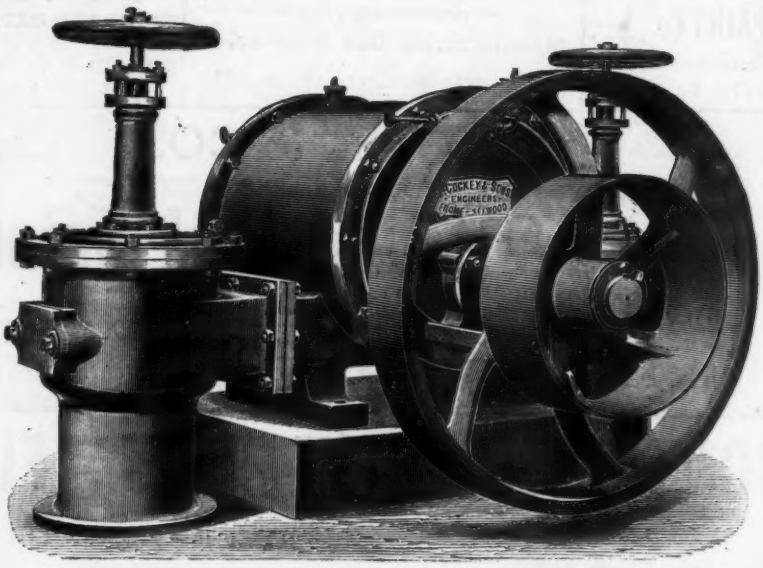
Apparatus for the manufacture of Sulphate of Ammonia.



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Lead Burning and Plumbing in all its Branches.

Gas-Fittings in great variety.

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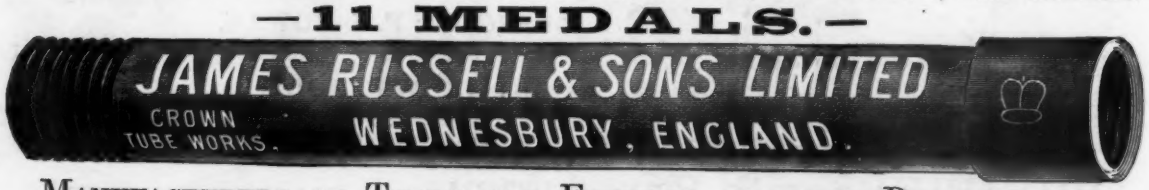

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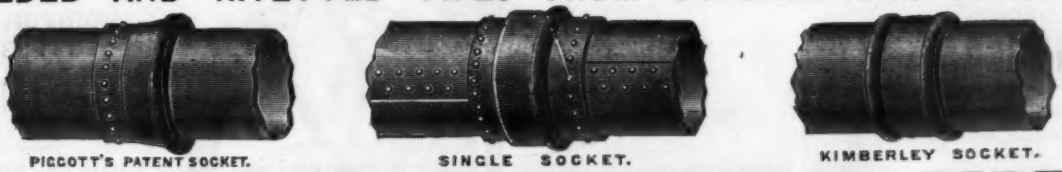
WELDED AND RIVETTED PIPES FROM 8-INCHES DIA. UPWARDS.



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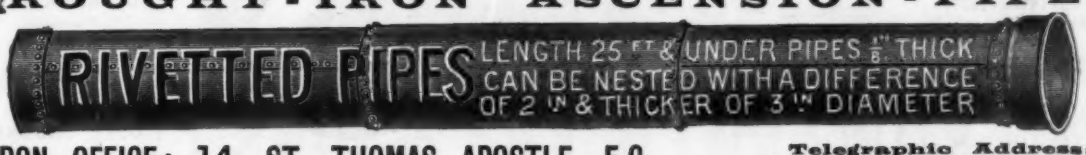

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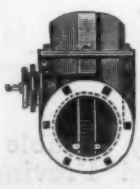
GASHOLDERS, AND Gasholder Tanks.



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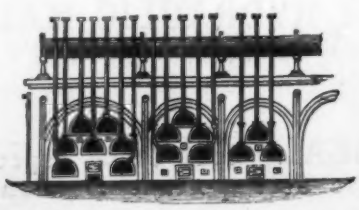
Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.



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PATENT CENTRE VALVES

for working Purifiers.

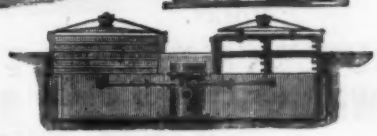
Also Bye-Pass & Stop Valves.

PURIFIERS with Planed Joints,

HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,

WOOD GRIDS.

CAST AND WROUGHT IRON TANKS AND CISTERNS.



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Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

CROSSLEY'S "OTTO" GAS-ENGINE.

100 Prize Medals.

MADE in SIZES
2-Man to 100-HP.

GAS-ENGINES
COMBINED
WITH
PUMPS
FOR
TOWNS SUPPLY,
SEWAGE, &c., &c.

GAS-ENGINES
COMBINED
WITH
AIR COMPRESSORS
FOR THE
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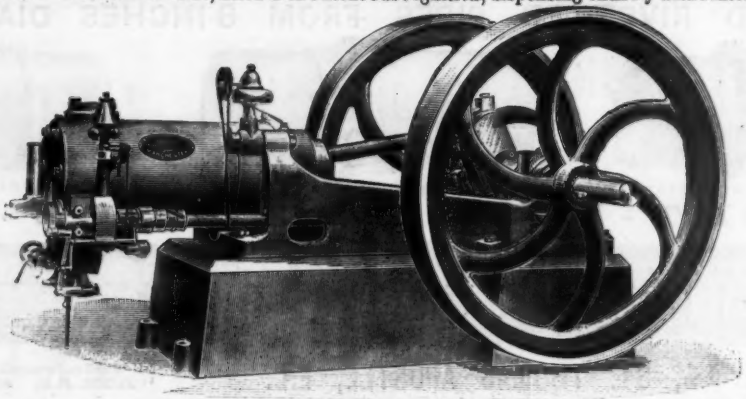
LIGHT, &c.

New 14-H.P. Nominal Size, fitted with Patent Tube Ignition, dispensing entirely with Plates.



MADE in SIZES
2-Man to 100-HP.

VERTICAL
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TYPES.

ENGINES
COMBINED
WITH
HOISTS, PUMPS,
DYNAMOS &c. &c.

Largely used for
EXHAUSTING,
PUMPING,
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Over **31,000** "OTTO" ENGINES are at work.

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MANUFACTURERS OF
FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.
GLAZED BRICKS AND PORCELAIN BATHS.

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Offices: 16, Great George St., Westminster. Works: Millwall, London.

Apparatus of every description for Gas and Water Works.

MORRIS & CUTLER'S PATENT "PERFECT" CONDENSER.
The most efficient condensing apparatus obtainable. In use at 60 Works, and now in course of erection at Melbourne, Hornsey, Winchester, Ware, &c.

LIVESEY AND TANNER'S PATENT DIFFERENTIAL TAR AND LIQUOR OVERFLOWS FOR HYDRAULIC MAINS.
A neat and effective apparatus to remove Tar from the Hydraulic Main and ensure a light Liquor Seal.
300 Sets in successful operation.

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CUTLER'S PATENT FREEZING PREVENTER AND CIRCULATOR for cups of Gasholders. Now being fitted to Holders at the Works of The Gaslight and Coke Company, and at the Imperial Continental Works at Hanover and Vienna.

Further particulars of these and other useful specialities will be supplied on application to the Westminster Office.

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HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,

NAPHTHA & GASOLINE DISTILLERS & PETROLEUM IMPORTERS,

SPECIALLY PREPARE GASOLINE OF ANY SPECIFIC GRAVITY BEST ADAPTED FOR CARBURETTING GAS; ALSO PETROLEUM ETHERS OF CONSTANT BOILING POINTS.

Prices and Samples may be had upon application.

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LONDON Offices & Depôts:
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WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.

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MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

ESTABLISHED MORE THAN A QUARTER OF A CENTURY

WORKS HUNSLET, LEEDS

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MAKE A

SPECIALTY OF

GASHOLDERS,

AND MAKERS OF

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GAS PLANT OF EVERY DESCRIPTION.

R. DEMPSTER & SONS, Ltd.,

ESTABLISHED 1855.

ROSE MOUNT GAS ENGINEERING WORKS.

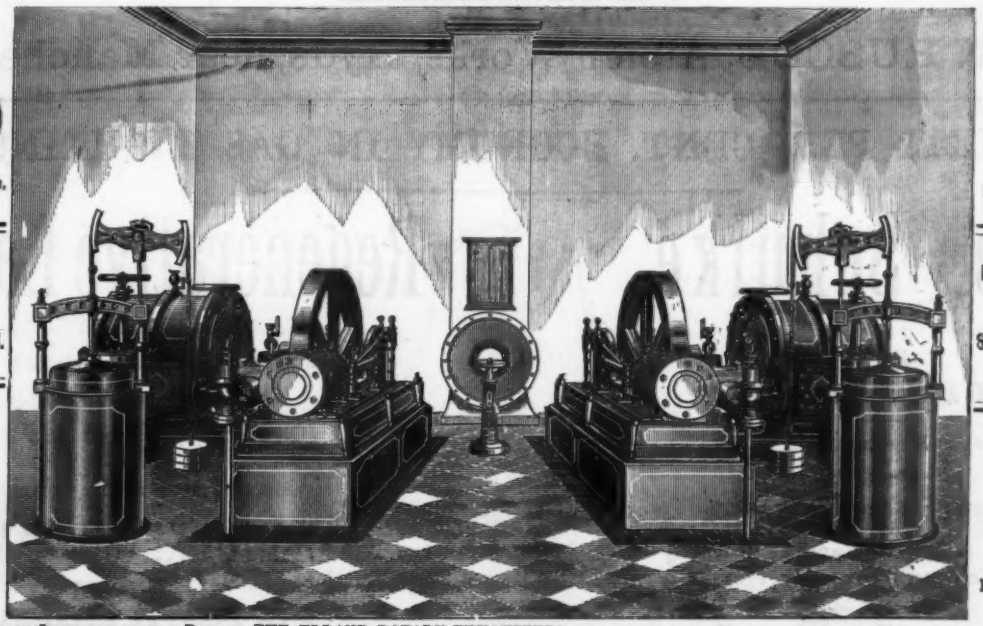
ELLAND.

No. 1. Flange Valve.

NO SLIP.

NO OSCILLATION.

No. 3. Screw Valve.



No. 5. Screw Valve.

NO HIGH SPEED.

STEADY GAUGE.

No. 6. Disc Valve.

THE ABOVE IS AN ILLUSTRATION OF A PAIR OF THE ELLAND ROTARY EXHAUSTERS ERECTED BY US AT WIGAN, EACH OF WHICH ARE CAPABLE OF PASSING 80,000 CUBIC FEET OF GAS PER HOUR.

Makers of every other description of Gas Plant, including Retorts, Retort Mountings, Condensers, Washers, Tar and Liquor Separators, Scrubbers, Purifiers, Gasholders any size, Patent Centre-Valves, Four-Way Valves, Rack, Screw, and other Valves.

Testimonials and References on Application to

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MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

RETORTS CAREFULLY PACKED FOR SHIPMENT.

A STOCK OF DIFFERENT SHAPES ON HAND.

GAS AND WATER PIPES

AND

CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

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MARK.	CLAY CROSS.	130, GT. SUFFOLK ST., S.E.

SULPHATE OF AMMONIA.

By Her Majesty's Royal Letters Patent.

DR. FELDMANN'S APPARATUS

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICES, APPLY TO THE

Sole Agents and Manufacturers,

GODDARD, MASSEY, & WARNER,

ENGINEERS,

NOTTINGHAM.

The Apparatus has been supplied to the following Firms—

BURT, BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (4 Apparatus).
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NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
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And to the following Gas Companies and Corporations—

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HALIFAX.	MARKET HARBRO'.	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
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DUKINFIELD.	DARWEN.	BOURNEMOUTH.
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RUSCOE'S PATENT MACHINE

FOR DRILLING AND TAPPING WATER-MAINS AND GAS-MAINS UNDER PRESSURE.

Patent Saddle Back and Drilling Apparatus, whereby Gas and Water Mains can have 2-in., 3-in., 4-in., 5-in., and 6-in. Branches put on without loss of Water or Gas.

Sole Maker of HELPS' PATENT PIPE EXTRACTOR.

Prices and Particulars on Application to

JOHN RUSCOE, Albion Works, Hyde, near Manchester.

SIXTY PER CENT. ECONOMY IN GAS LIGHTING.

The Schülke Regenerative Lamp

FOR

DOMESTIC AND EXTERNAL LIGHTING.

The only Regenerative Lamp employing the Common Flat-Flame Burners.

Lamps giving 20-Candle power consume less than four feet of Gas per hour.

PURE WHITE & PERFECTLY STEADY LIGHT,

NOT AFFECTED BY DRAUGHTS.

Suitable for any existing fittings (Brackets or Suspending).

Can be fixed in a few minutes.

May be seen at the Offices of the

SCHÜLKE GAS-LAMP Co.

LIMITED,

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LONDON, W.C.,

Where Price Lists and full particulars may be obtained.

KIRKHAM, HULETT, & CHANDLER'S, LTD.,

[SIDNEY HERSEY, Managing Director.] **NEW PATENT** [J. CHANDLER, Engineer.]

"STANDARD" WASHER

EXTRACTS the WHOLE of the AMMONIA

Also a Large Proportion of H_2S and CO_2 from Gas.

Has been in operation over two years at the Beckton Station of The Gaslight and Coke Company. (See below.)

TESTIMONIAL FROM THE CHIEF ENGINEER OF THE GASLIGHT AND COKE COMPANY.

The Gaslight and Coke Company, Horseferry Road, Westminster, S.W.,
Nov. 25, 1889.

MESSRS. KIRKHAM, HULETT, AND CHANDLER, LIMITED,

GENTLEMEN,—In reply to your enquiry respecting the result of putting "Wooden Bundles" into some of the Washer-Scrubbers at our Beckton Station, I beg to say they have answered admirably for the few months they have been in; and I think them a decided success.—I am, yours truly,

(Signed) G. C. TREWBY.

Order just received from the BIRMINGHAM Corporation for new patent "Bundles" for RENEWAL THROUGHOUT the 5,000,000 cubic feet per day "Standard" Washer erected in 1882.

For List of "Standard" Washer-Scrubbers supplied of above-mentioned pattern and renewals effected by application of same to old pattern machines, see last and next weeks' issue of the JOURNAL.

PALACE CHAMBERS, BRIDGE STREET,

WESTMINSTER, S.W.

R. & J. DEMPSTER,

GAS PLANT WORKS, NEWTON HEATH, MANCHESTER,

MAKERS AND ERECTORS OF

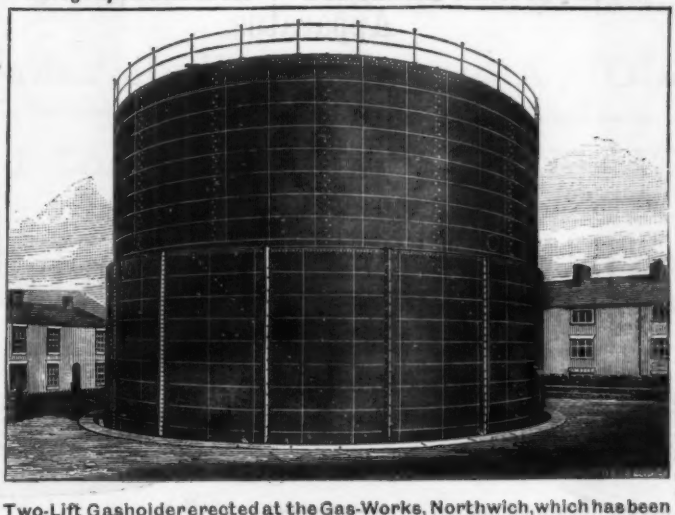
PATENT COLUMNLESS GASHOLDERS.

Telegraphic Address: "SCRUBBER MANCHESTER."

TOTAL WEIGHT REDUCED
from 30 per cent. to 50 per cent.

TRANSPORT AND ERECTION REDUCED
to the same extent; and in cases where gasholders are shipped abroad to places difficult of access, this represents a very large amount of money.

TANK CONSTRUCTION SIMPLIFIED.
The Tank wall (of whatever construction) is a regular cylinder. There are no piers needed, and all expensive foundation stones for the base of columns or standards are dispensed with.



Two-Lift Gasholder erected at the Gas-Works, Northwich, which has been in continuous work since Jan. 3, 1890, and has been subjected to most severe tests from heavy gales, with perfectly satisfactory results.

COST OF PAINTING SAVED
for the Columns and Girders.

TILTING UTTERLY IMPOSSIBLE;
And as there are fewer parts, there is less liability for the Gasholder to get out of order in working.

STABILITY UNDER WIND PRESSURE
of a Gasholder constructed upon this system is at least equal to, and from experiments and calculations made is far in excess of, that of a Holder of the same dimensions guided by the elaborate guide framing at present in use.

The removal of heavy guide carriages and rollers from the top curbs considerably lowers the centre of gravity of the structure, and dispenses with the extra strength of sheeting necessary to carry these at the points where they are attached to the gasholder.

The plan adapts itself to telescoping to any reasonable extent, and enables very shallow holders or lifts to be employed with perfect stability.

FOR FURTHER PARTICULARS AND ESTIMATES, APPLY TO THE ABOVE.

R. LAIDLAW & SON.

IMPROVED WET AND DRY GAS-METERS

IN CAST-IRON AND TIN CASES.

Two Gold Medals, One Silver Medal, One Bronze Medal, and Two Honourable Mentions,

INTERNATIONAL EXHIBITION, EDINBURGH, 1886.

PRESSURE REGISTERS.

A LARGE STOCK OF GAS AND WATER METERS ALWAYS READY FOR IMMEDIATE DELIVERY OR SHIPMENT.

STATION METERS,

WITH ROUND OR SQUARE CASES.

Improved Station and Exhauster Governors.

Lamp Pillars,

WITH EITHER WET OR DRY METERS FOR AVERAGE METER SYSTEM.

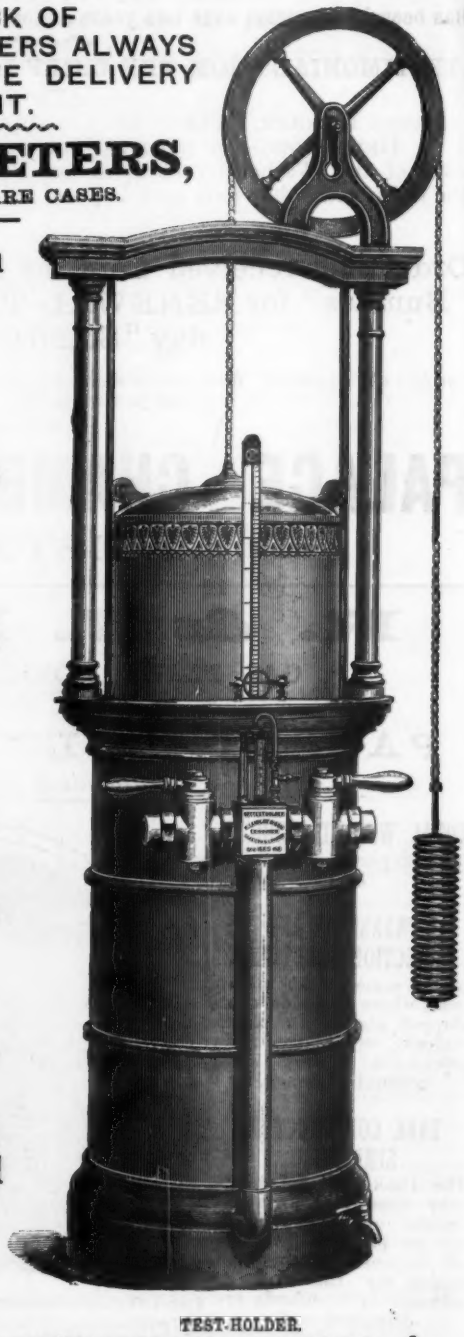
Experimental Hourly-Rate and Test Meters.

Experimental Apparatus.

Pressure Gauges.

Condenser Thermometers.

Siemens' Patent Water Meters, and Gas Apparatus and Fittings.



TEST-HOLDER.

STANDARD TEST-HOLDERS AND TEST-METERS FOR OFFICIAL INSPECTORS, &c.,

AUTHORIZED BY THE BOARD OF TRADE STANDARDS DEPARTMENT.

ALLIANCE FOUNDRY, **GLASGOW.** | SIMON SQUARE WORKS, **EDINBURGH.** | 6, LITTLE BUSH LANE, **LONDON, E.C.**

IMPORTANT TO
GAS ENGINEERS AND GAS MANAGERS:

The most Economical, Reliable, and Handy Tool for Forge Work for

ENGINEERS, MACHINISTS, TOOL MAKERS, FITTERS, FORGERS, STAMPERS, COACH BUILDERS,

AND FOR USE IN

GAS-WORKS, SMITHIES, IRON-WORKS, COLLIERIES, &c., &c.,

IS

THE TANGYE GAS-HAMMER

(ROBSON & PINKNEY'S PATENTS)

As supplied to several of the principal Gas-Works.

TANGYES LIMITED
SOLE MAKERS.

As supplied to several of the principal Gas-Works.

Hand Gear. (*From Photos of the ¾ cwt. size.*) Foot Gear.

THE above illustrations represent THE TANGYE GAS-HAMMER as now made. Since its introduction it has been greatly improved both in design and simplicity of working. It has also been constructed to work either with Hand Gear or with Foot Gear.

This—the first Gas-driven Forging Hammer introduced—was designed, and at first recommended only for use in cases where steam was not available or could only be employed at great expense, but the data given below, and which are founded upon reliable and sustained test and trial, demonstrate that the **GAS-HAMMER** may be economically used in competition with the Steam-Hammer, even in places where the price of gas is at its highest.

"*Since the appearance of our* ['*The Engineer*'] *notice, the Hammer has been in some respects re-modelled, and its remarkable economy placed altogether beyond a doubt. . . . The Hammer described is that known as the ¾ cwt. size, and has a cylinder of 7 in. diameter and 6½ in. stroke. The maximum blow is very nearly that which would be given by* **a weight of 3 cwt. falling through a height of 1 ft.**; *and this can be repeated at the rate of* **110** *blows per minute. . . . Extended test in practical smith work has demonstrated that over* **2500 of the heavier blows** *referred to above, can be given with* **one pennyworth of gas** *at half-a-crown per* 1000 *feet—i.e., the Birmingham price to small consumers—or over* 4500 *varying blows for the same consumption.*"—"**The Engineer,**" **Sept. 10, 1886.**

The Gas-Hammer dispenses with Boilers, Coals, Ashes, and Dirt necessitated by Steam-Hammers.

It is ready for work at any moment, day or night, and works as economically for a few minutes' spell as when in sustained operation.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JANUARY 6, 1891.

The Effect of Gas and Glass upon Shop Hours.

WHENEVER the social aspects of gas lighting are mentioned, as they must be in any comprehensive survey of the results of the new industry which Murdoch created, it is customary to lay particular stress upon the educational and humanitarian results that have followed upon this improvement of the means of lighting large interiors. In the beginning of the century which is now in its last decade, the number of halls in London suitable for large public assemblies after dark might be counted upon one hand. The theatres were the only really popular places of evening entertainment in the capital or any of the large towns; and these did not require better lighting than candles or train oil could afford, so long as such illumination as could be obtained from the means at disposal was concentrated upon the stage. Evening dances and musical entertainments cost the rich vast sums in wax candles; but people to whom expense was an object of solicitude had to be content with wall sconces for single candles, supplemented for large rooms by hoops dependent from the ceiling, and carrying a few of the universal tallow dips. The lighting was never good enough for an assembly in a large room to read, or write, or in short do anything instructive; consequently, the inauguration of Mechanics' Institutes, Mutual Improvement Societies, and classes for evening study, could not have taken place before the time when gas lighting had rendered the use of large interiors practicable, and had facilitated traffic through the streets at night. What the last two generations of townspeople owe to the civilizing results of gas lighting can never be accurately gauged. We cannot be far wrong, however, in ascribing the extraordinarily rapid increase in the rate of intellectual progress on the part of our people during the middle of the century, as compared with that of any previous period of equal duration of which history presents any record, to the prolongation of the hours available for study, and the improvement of the means of teaching, due to gas lighting.

This being so, it would be against the nature of things in general if there were no other side to the picture. Has the general improvement of artificial lighting in towns had any results that may be regarded as drawbacks? Probably. We know, for example, that the early admirers of street gas-lamps confidently expected that these would exercise a deterrent effect upon the public vice of town populations, as well as prevent crime and facilitate the detection of offenders. The last results have certainly been secured; for it is generally recognized that a gas-lamp constantly burning is a better protection to exposed property than the occasional visits of a policeman. It cannot be argued, however, that the moral influence of street lighting amounts to much, if to anything at all. Indeed, it might be argued that to render streets attractive by luxurious lighting—to turn them from thoroughfares into promenades—is not to favour morality, but rather the reverse. And this consideration leads to another division of the subject, and that is the effect of improved lighting upon certain branches of trade and those engaged in them.

A journal published in the interest of warehousemen and drapers recently remarked that, at a meeting of men employed in these trades, the question was asked how late shop hours came about. The editorial opinion on the matter was that "originally"—whenever that may have been—work ended with sunset. In support of the notion that this primitive epoch of retail commerce was not very far distant in the past, the poet Gay is called in evidence. Now, Gay was a mercer of London City in the early part of the past century; and, in beginning the last book of his "Trivia," he mentions the shutting of the shop-windows "when night first bids the twinkling stars "appear." The comment goes on to state that, "under "the rule of cotton wicks, early closing was a matter of "course." Then we are told that "before the end of the "century, the lighting of the streets had so much improved "that a new habit of going out after dark had grown up, "to which shopkeepers were quick to accommodate themselves; and although some parts of London, as late "as 1819, were still left to the flickering mercies of oil-"lamps, gas had by that time become general, and had "done its worst in destroying the ease and leisure of "shop assistants. They began then their long revolt "against late hours." It was not gas alone that was supposed to have afflicted the unhappy drapers; the repeal of the duty on glass had assuredly something to do with it. "With the freedom of the trade (in glass) "from official regulations and taxation, large and still "larger panes began to take the place of the narrow "squares of old shop-fronts, and to the public gas and "glass together proved irresistible. And that was how "late hours came about, and made shop assistants the "modern Slaves of the Lamp." All this is plausible; and we should be rather ashamed of the part played by gas if it were true that this means of shop and street lighting has in reality been responsible for injuring shop assistants. Fortunately for the reputation of gas, we hope to be able to show, in a very few words, that it did not create the evil complained of. Gas-lamps, like the

blessed sun himself, are made to light the way to much wrong-doing; but to charge the evil practices of man upon his tools instead of upon himself, is a mistake as well as an injustice, since by diverting attention from the cause to the agency it throws reform off the right track. If a heavy duty were placed upon the trade use of gas and glass to-morrow in the supposed interest of shop assistants, it is idle to pretend they would be benefited; and therefore it is illusory to talk of their unrestricted use as having injured the class in question.

Furthermore, it is absurd to argue that gas and plate glass have any real connection with long shop hours, seeing that in Continental cities, where the English shop-front is hardly known, and the attractions of gas are but little understood by tradesmen, the hours of assistants and clerks are longer than is the rule in this country. On the historical aspect of the question, again, we doubt if our complaining contemporary is altogether right. On general principles, it is rather hazardous to follow implicitly anybody who assures us that the "good old times" were better in any respect than our own. It would be safer to take up the position that the life of the community, as a whole and for every particular class, is better circumstanced to-day than was possible a hundred years ago. The idea that modern trade, modern competition, or modern commercial conditions of any kind have operated detrimentally to the employee or labourer of any grade, as compared with the state of his precursor of a past age, is a fallacy that might only be expected from the mouth of Mr. John Burns, or some other half-instructed professor of the tenets of the New Unionism. All such assertions are late survivals of the old delusions about the state of man in the Golden Age of Nature, with which the idealists of the last century prepared the way for the great French Revolution. They evolved from their inner consciousness a Natural Man, endowed as a birthright with all the virtues, knowledge, and liberties which they conceived such a being ought to have; and they taught the actual men around them that their deplorable state was the result of the machinations of their rulers, who had deprived them of their birthright for the sole benefit of those having the upper hand in the world. The logical inference from this was that when the robbers were disestablished, mankind would have its own again. We all know well how that idea worked in practice. The Socialistic Unionist is as bad as the old French *philosophe*, only his immediate grievance is against economic, not social laws. Instead of bemoaning in polished language the degradation of the Natural Man, he sets up an Imaginary Workman—or, as in the case in point, an Imaginary Shop Assistant; but he makes as grave blunders as the *philosophe* in his estimates of the manner in which the ideal past became the actual present. The truth is, of course, that there never was any Golden Age, either for mankind in general or for any class in particular; and that those who frame their thoughts and erect their theories of reform upon this basis, have got hold of the stick by the wrong end.

In the present case, we can prove all that is necessary to the exposure of error by pointing out to those whom it may concern that in the time of Gay, the mercer and poet, there was no class of shop assistants, in the modern acceptation of the term; so that this could not have been their Golden Age. Shopkeeping in that day was what would now be looked upon as a very small affair. The mercer, or any other tradesman, lived in as well as by his shop, which was part of his dwelling-house; and he was assisted behind the counter and at his books by the members of his family, together with a very few apprentices and servants. What would Poet Gay or Captain John Gilpin have said if they had been vouchsafed a vision of the shop assistant of the present day? Their young people had to black the master's boots as well as serve customers, and take the parcels home afterwards. Does the drapers' oracle imagine that these young people had nothing to do but amuse themselves after the shop was shut? We shrewdly imagine that if the smart young shopman of the existing type, who is twice the man that his predecessor of the last century was, could be sent back for a week to Gilpin's place of business—say, just before that memorable holiday by which Mrs. Gilpin proposed to break the monotony of the City life of the period—he would proceed, immediately after his return, to enlighten in the truth of history that false teacher of his who now says he is a slave to gas and plate glass.

The Corporation of London on the Defunct Coal Dues.

The Corporation of London cannot yet forget the dear departed coal dues. With this abolished impost, it is truly a case of "tho' lost to sight, to memory dear." As a fond tribute to the *manes* of the venerable impost that died so quietly at last, after an existence of upwards of 600 years, the Coal, Corn, and Finance Committee of the Corporation recently issued a final moan over the dues, in the form of a report on the fluctuations or alterations in the price of coal in London since they ceased to be levied. The Corporation very well knew, before the Committee was ordered to report upon this matter, that the price of coal had gone up; and their only desire was to try to connect this rise by some means with the removal of the dues. There was also a desire to exhibit the London County Council, who had consented to the abolition of the impost, as a rash and inexperienced body of theorists; and to fix upon the newer authority a reputation for foolishness in wantonly throwing away a source of revenue that was "not felt by "those who paid it," which should cause them to compare unfavourably with the wise old Corporation. In short, the whole purpose of the report in question was to justify the Corporation in saying, "I told you so!" when any consumer of coal in London should complain that, although the tax of 1s. 1d. per ton has ceased to be levied, his coal bills are heavier than before. This is a piece of cunning, perhaps; but it is not wisdom. It is on a par for childishness with the attempt of the Corporation to obtain the support of the House of Lords and the Court party in Parliament—if there is such a party now-a-days—by arguing that the removal of the dues would cause more coal to be burnt in London, and thus make the capital more objectionable than ever to aristocratic daintiness. It is notorious that the County Council had nothing to do with the removal of the dues. Both parties in Parliament had pronounced against their retention, and it would have been the height of futility for the new representative body to ask for a continuance in their favour of that subsidy, the possession of which redounded so little to the advantage of the authority which they superseded. But, apart from all questions of responsibility for taking off the coal dues, it is idle for the Corporation to talk of the price of coal in London since their removal, without regarding its value in other parts of the country. If the loss of the tax forced up the price of coal in London, it did the same for Newcastle, Manchester, and Liverpool—which is absurd. We may be very sure that if an era of bad trade, low wages in the mining districts, and cheap coal should set in, the Corporation of London will take no notice of the result as illustrating the other side of the question. Nothing that the old Corporation has done of late years savours so painfully of dotage as the attitude taken up with regard to this subject of the London *octroi* on coal.

A Defence.

Apparently, but certainly unintentionally, we have made the American Eagle scream. At least, it appears to be a scream that *Progressive Age* desires to raise on some remarks that were printed in our editorial columns on Nov. 11 and 18 last, with reference to the Savannah meeting of the American Gaslight Association and Mr. M'Millin's presidential address on that occasion. The sound is only a very feeble squeak, after all; still, it is the best our water-gas contemporary can do, and we take note of it accordingly. We are accustomed to follow the affairs of the gas industry of the United States with interest and sympathy; having many good friends and correspondents engaged in American gas-works. Moreover, there is not a gas engineer's office of any note in the whole of North America where the Journal is not welcomed as the most comprehensive and authoritative organ claiming to represent the gas-lighting industry—first of Great Britain and afterwards of the universe. It is not our custom to write in this strain; but we are dealing for the moment with America, and are not inclined to undervalue ourselves in the face of a community habituated to the most blatant self-advertisement on the part of its technical and ordinary journals. Notwithstanding the circumstance that the technical provender supplied to their patrons by the three gas journals of the States would come lamentably short if their conductors had not our pages to draw upon every week, one of these publications at least—*Progressive Age*—cannot away with us. Now, it is a well-understood fact that when the general press of

the United States raises the scream of the American Eagle, it is usually on a question of pork; and, similarly, when *Progressive Age* squeaks, it is because we have insulted water gas, or the makers of, and dealers in, this other great American specialty. We dared to remark, with reference to President M'Millin's address, that the orator, while admitting that water gas has of late years made great strides among the Gas Companies of the States, hinted that this was "not altogether by reason of its own "intrinsic value." Our contemporary is so irate at our putting this interpretation upon Mr. M'Millin's guarded expression, that it cannot stop to correct literals or even to write grammatically in its denunciations of our "unfair-"ness," "ignorance," and "disingenuousness" in pretending to treat of the condition of the gas industry of the United States. We are attacked on other points; but it will be sufficient to confine our reply to this matter of the spread of water gas in the States, as it is the only question worth mentioning a second time in connection with the comments made upon the Savannah meeting. President M'Millin's words were as follows: "A few years ago "there were strifes existing between various systems of "gas making; coal-gas men were solidly arrayed against "water-gas advocates." This would be the era when the Lowe water-gas people started a newspaper of their own, which has now developed into *Progressive Age*. "To-day," Mr. M'Millin continued, "there are few large "cities in the country but what are supplied, at least in "part, with water gas." This is praise for the water-gas interest, if their success has really been fairly earned. But, says Mr. M'Millin, with the reserve befitting his position, "there may be works making water gas that "might, *with advantage to their stockholders*, have continued "to make coal gas." He could not well have said more; and we have no desire to expand the reference by citing names of places in the States where water gas has been forced upon communities by methods which, when unsuccessful, are called "piracy," "raiding," and similar picturesque names for what we on this side the Atlantic should describe as downright roguery. That there are such places between Massachusetts and Nebraska, not even *Progressive Age* would have the effrontery to deny, although it has been pretty daring in denial and assertion from the days when it affected to ridicule the idea that a poisonous gas could be concocted from fire and water, which, if we remember rightly, it once described as two of the purest elements in Nature. We should not willingly rake up these old slips, or take the trouble to meet new abuse; but when we are loftily assured that we know nothing at all about the circumstances of the great American gas industry, and never did know anything about it, we are tempted to say something by way of reply. Water gas no doubt honestly deserves its adoption in some places; but it has nevertheless been made a tool of by unscrupulous speculators in other localities, where circumstances and lax laws have favoured operations on gas stocks that in any other country would be called swindles.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 32.)

THE progress which the markets in general have made in the course of recovery during the past week has been on the whole satisfactory, considering the interruption of the holidays, and the impediments to a full attendance caused by the severity of the weather. The improvement was more pronounced during the earlier portion of the week. The Gas Market was very fairly active and firm; all variations in quotations being for the better. Gaslight issues secured the most of the profit; "A" leading the way with a rise of 4. Business was marked on Tuesday as high as 245; but subsequent transactions fell short of this figure. The secured issues continue in request; and some of the preference stocks are quoted higher. A very little was done in South Metropolitans, at unchanged rates. Nothing at all was marked in Commercials, probably owing to lack of sellers. Suburban and Provincial undertakings are quite devoid of interest, and present no change. The Foreign division in general are firm, and moderately active. Many issues, both Home and Foreign, are worked *ex div.* from last account; and the fractional variations are uniformly in favour of better prices. The Water Companies have been almost unheeded all the week; the only changes in price being due to *ex div.* corrections, which are also fractionally better.

The daily operations were: Very little doing on Monday; but the turn was favourable. Gaslight "A" rose 2. The same may be said of Tuesday; and Gaslight "A" made a further advance of 1. Wednesday was a repetition of the previous day; and another advance of 1 was marked by Gaslight "A." The *ex div.* variations are noted in the stock and share list. Thursday was a close holiday. The business of the New Year opened rather more briskly on Friday; and prices kept up well. On Saturday, despite the general quietude, Gas was fairly busy, and quotations moved up. Gaslight "C," "D," and "E" improved 2; ditto "F," 1½; ditto "J," 1; and Metropolitan of Melbourne, 1.

In accordance with our usual practice, we append a comparative table of the quotations of Gas and Water Securities at the close of 1890, and as they were twelve months previously—showing their respective gains and losses. It is scarcely possible to satisfactorily analyze or classify these; market movements having been somewhat capricious. In considering the list of Gas undertakings, it must be borne in mind that this time last year labour troubles were acute, and the South Metropolitan strike was hotly raging. Since that decisive action, a new element of disturbance (and one which, monetarily, is of far graver importance) has arisen in the great advance of the price of gas coal, though the market appears to be, as yet, singularly heedless of the fact. The Water Companies have, as a class, undergone some reaction from their previous liberal advances; having, nearly all, retrogressed in quotation except the two Companies (Chelsea and Southwark), which have declared higher dividends for the last half year.

NAME. GAS COMPANIES.	Prices on Dec. 31, 1889.	Prices on Dec. 31, 1890.	Gain or Loss.
Alliance and Dublin Company, 10 per cent. maximum	17—18	16—17	−1
Do. 7 per cent.	12½—13½	12—13	−½
Australian (Sydney) 5 per cent. Debentures	110—112	107—109	−3
Bahia, Limited	20—21	17—19	−2½
Bombay, Limited	6¾—7	6¾—7¼	+¼
Do. New	4¾—5¼	5—5⅜	+¼
Brentford, Consolidated	218—223	212—217	−6
Do. New	158—163	155—160	−3
Brighton and Hove, Original	41—43	40—42	−1
British	43—45	43—45	—
Bromley, Ordinary 10 per cent.	19—21	18—20	−1
Do. 7 per cent.	13—15	13—14	−½
Buenos Ayres (New), Limited	13—14	11—12	−½
Do. 6 per cent. Debenture	107—110	103—106	−4
Cagliari, Limited	25—27	26—28	+1
Commercial, Old Stock	242—247	250—254	+6½
Do. New do.	195—200	198—203	+3
Do. 4½ per cent. Debenture Stock	117—122	117—122	—
Continental Union, Limited	47—48	47—49	+½
Do. New 1869 and 1872	32—34	32½—33½	—
Do. 7 per cent. Preference	36—38	37—39	+1
Crystal Palace District	200—205	195—205	−2½
European, Limited	22—24	19—20	—
Do. New	17—18	19—20	—
Do. do.	11—12	13½—14½	—
Gaslight and Coke, A, Ordinary	244—249	240—245	−4
Do. B, 4 per cent. maximum	100—105	98—101	−3
Do. C, D, and E, 10 per cent. Preference	248—253	249—254	+1
Do. F, 5 per cent. Preference	123—128	119—123	−4½
Do. G, 7½ per cent. Preference	182—187	177—182	−5
Do. H, 7 per cent. maximum	157—162	164—168	+6½
Do. J, 10 per cent. Preference	247—252	247—252	—
Do. 4 per cent. Debenture Stock	112—115	111—116	—
Do. 4½ per cent. Debenture Stock	121—125	121—125	—
Do. 6 per cent. Debenture Stock	160—170	158—162	−5
Imperial Continental	213—218	220—225	+7
Malta and Mediterranean, Limited	5—5½	5—5½	—
Metropolitan of Melbourne 5 per cent. Debenture Stock	113—115	109—111	−4
Monte Video, Limited	18½—19½	18½—19½	—
Oriental, Limited	8½—9	8½—9½	+½
Ottoman, Limited	5⅞—6¼	5—5¼	−⅞
Pará, Limited	3¾—4¼	3—4	−¾
People's Gas of Chicago, 1st Mtg. Bds.	100—105	93—100	−5
Do. 2nd do.	95—100	93—98	−2
San Paulo, Limited	14½—15½	15—17	+1
South Metropolitan, A Stock	295—305	280—285	−17½
Do. B do.	228—233	228—233	—
Do. C do.	240—250	235—245	−5
Do. 5 per cent. Deb. Stk.	135—140	140—145	+5
Tottenham and Edmonton, Original	11—13	—	—

NAME. WATER COMPANIES.	Prices on Dec 31, 1889.	Prices on Dec. 31, 1890.	Gain or Loss.
Chelsea, Ordinary	260—265	267—272	+7
East London, Ordinary	211—215	213—218	+2½
Do. 4½ per cent. Debenture Stock	141—144	140—145	—
Grand Junction	125—130	117—122	−8
Kent	276—281	273—278	−3
Lambeth, 10 per cent. maximum	251—256	245—250	−6
Do. 7½ per cent. maximum	197—202	195—200	−2
Do. 4 per cent. Debenture Stock	120—124	120—124	—
New River, New Shares	364—369	360—365	−4
Do. 4 per cent. Debenture Stock	127—130	125—128	−2
Southwark and Vauxhall, 10 per cent. max.	167—172	175—180	+8
Do. 7½ per cent. maximum	163—168	167—172	+4
West Middlesex	260—265	260—265	—

ELECTRIC LIGHTING MEMORANDA.

The "World" on the Prospects of Electric Lighting Companies—Gas and Electric Lighting and Ventilation—Electrical Subways.

A SOMEWHAT silly article on electric-light companies and their prospects has recently appeared in the *World*. We call this effusion "silly," because it is couched in the strain of undiscriminating laudation of electric lighting which characterize

journalistic references to the new illuminant ten years ago. Surely, it might be thought, enough experience of the peculiarities of electric lighting should by this time have penetrated to the consciousness of any newspaper writer to prevent him from excepting this from the rule of fallibility that prevails with regard to all other human devices. But no; the *World* essayist still pretends that electric lighting is a perfect boon to the community. The motive for this confident manner of treating the subject may be considered by a captious critic to peep out in the writer's casual remark that "the new industry is a mine of wealth to its pioneers and shareholders." Seeing that the shares of all the electric light companies in existence are quoted at considerable discounts, it is very good of the *World* to invite all and sundry to this Tom Tiddler's ground, where they may expect to pick up gold and silver to their hearts' content. This playful genius goes on to describe "the gas man" as being "dead as a dodo." If so, he is indeed a very lively corpse. The writer refers to the early days of gas lighting and its difficulties as being analogous to those of the electric light; but he naturally says nothing about the difference between the two experiences, which are of more real significance than their resemblances. Where he "lets himself out," as the Yankees would say, is in his calmly impudent assertion that electric lighting is "infinitely less dangerous than gas." He goes on to state that "you may, if you like, easily blow up your house with gas; the utmost mischief you can do with your electric wires is to spoil them." This, after the experience of the fire insurance companies—and in the West-end of London, too—is sheer impudence, which even the electrical journals will not back up.

One of the two leading publications devoted to the electric lighting interest in this country—the *Electrician*—recently reproduced entire an article from our columns on electric and gas lighting and the ventilation of public buildings, in which we ventured upon the assertion that the ventilation of the lecture theatre of the Society of Arts, among other places, has not been improved by the introduction of incandescent electric lamps in place of the gas sun-light formerly used for the lighting. In an editorial comment upon this article, our contemporary graciously recommended electric lighting engineers to look into our pages occasionally, and see what we have to say about their doings; kindly admitting at the same time that our criticisms "show a much more creditable knowledge of the subject than is exhibited by the daily press." Although we might complain that this is "damning with faint praise," indeed, it is hardly worth while to protest against the patronizing tone held by an electrical print with regard to a gas publication, seeing that electricians habitually treat the whole gas interest as belonging to an inferior sphere. With regard to the main question, the *Electrician* does not even attempt to contest our point, but admits that the *desideratum* in hall lighting is "a sun-light with ample flue." We say that, while one is about it, one may as well burn gas in the sun-light, and so get reliable lighting at a reasonable cost, together with a sharp ventilating exhaust. The electricians, of course, urge that the light had better be supplied by themselves, although gas may continue to be burnt for the sake of creating a ventilating draught. The difference is a perfectly natural one as between representatives of two interests; and it must be left for the public to judge in the matter.

The opening, after some delay, of the City and Suburban underground tramway, which connects London Bridge with Stockwell by means of tunnels at a depth of about 50 feet below the surface of the ground, was one of the events of the closing weeks of the past year. We have already mentioned this interesting and important undertaking on more than one occasion. Its significance for us lies mainly in the unprecedented use that has been made of electricity in the traction and lighting of the trains, and for working the passenger lifts at the stations of the new line. Electricians have for some time freely admitted the fact that there is a vastly greater field for them in road and rail traction than in lighting; and it was obvious that if electrical haulage is practicable at all, it must be in such circumstances as that of the City and Stockwell subway. It gives us pleasure to be able to record that, with but one noteworthy break-down, this experiment has so far worked well. There is any amount of traffic on the line followed by this subway, which is one of the principal omnibus routes out of the City. If it does not pay, therefore, it will not be through want of patronage, but on account of some imperfection in the locomotive plant. The success of this venture will certainly lead to others, not only in London, but also in other centres of population, where surface traffic is congested. Whatever interested parties may say, neither Parliament nor British local authorities will consent to the spoiling of their roads by the American style of electrical tram-lines driven from overhead wires. Objections to these devices are even graver than those applying to overhead electrical lighting wires. Where the traffic is sufficient to warrant the construction of an underground tramway, however, electrical traction, if cheap enough, is manifestly the right thing for it; and it would not be surprising if the success of the Stockwell line inaugurates a new era in the matter of town and suburban locomotion. Roads and railways have long been overloaded in and about London; and it is high time some relief was obtained by some new method of assisting circulation.

AIDS TO PROGRESS FROM THE PAST.

At the beginning of a year one looks backwards and forwards, and wonders what will happen during the new era that has dawned upon the world. It is therefore an appropriate season for thinking over the things that have been, and tracing in them the promise of those that shall be; for it is a truth not sufficiently borne in mind, that the cry which assures us of there being "nothing new under the sun" has many and various applications. In engineering, chemistry, and manufacture, the old contains the new; so that one of the commonest troubles inventors is the risk of discovery of some long-forgotten anticipation. It so happens, moreover, that inventors are not, as a class, remarkable for their knowledge of the history of the arts and industries which they essay to improve. They hit upon some ingenious method of overcoming a more or less obvious difficulty; and very often take it as a personal slight if anybody ventures to doubt their originality. It is not until after they have formulated their own proposals that inventors usually betake themselves to searching the records of the Patent Office; and then they are oftentimes too deeply persuaded of the merit of their project to do more than trace differences between it and the earlier suggestions that come nearest to it. It would be expecting too much of human nature to suppose that a sanguine inventor should pay as much, or more, heed to the resemblances between his own device and those which seem most nearly to have anticipated it, than to their distinctions; but it would be the wiser course to follow.

Inventors, we have observed, are not as a body remarkable for their historical studies; and we should not be far wrong in stating deliberately that it is the ignorance of the great majority of inventors of what has been done before them that brings the bulk of the grist to the mill of Patent Agents, and supports the Office itself. This is especially true for the United States, although our own new patent law is making it equally applicable to the United Kingdom. We do not esteem a vast number of applications for patents for mechanical inventions an infallible indication of the spread of true mechanical and chemical knowledge among the people. Rather should we say that it indicates a widespread smattering, chiefly in the matter of mechanical "notions," a hastiness in endeavouring to pick out plums from the industrial pie, and indifference to history. The great majority of American and British applicants for patents are mere "notionists," if we may be permitted to coin a word for the purpose of describing them. They have no exact knowledge of the subject-matter of their supposed discovery; and all they have in mind is the prospect of making money by establishing property in a "lucky hit." Naturally, there is not 5 per cent. of such patents that pay expenses. The once sanguine patentee discovers sooner or later, according to his powers of perseverance, and the length of his purse, that what is good in his notion is not new, and what is new is of very little good; and so he drops it, a disappointed man. The patents that turn out best are those taken out with serious purpose and full knowledge by inventors who know the subject-matter by trade experience, or have mastered it by long study. But these are the minority. As a rule, the more deeply versed a man is in any department of mechanics and manufacture, the less apt is he to trouble the Patent Office with notions. He knows too much to pin faith to any happy thought, such as too often dazzles the inexperienced with hope of suddenly becoming rich without labour or anxiety.

A striking illustration of what has just been stated is supplied by the history of gas carburetter patents. Hardly any class of patents has paid the Patent Offices and Agents of this country and the United States more than this; and none has cost inventors more for so little return. There is a fatal facility about carburetting gas that has entrapped thousands of aspirants for sudden wealth by this way; but very few experts in gas are to be found among them. Not the most perfervid admirer of inventions, for inventions' sake, could pretend that the mob of gas carburetter inventors have done themselves or the gas industry any noticeable amount of good by their fatuity. Sir Frederick Bramwell and others who have taken a professional interest in patentees, have assured their *protégés* again and again that they are the glory of their nation, and deserve national support and encouragement. What have the gas carburetter inventors and patentees done to deserve anything of the kind? We use this particular class of patents merely as an example, for the sake of argument. There are many other subjects against which the same kind of patentees—the notionists—have habitually run their heads in crowds, as may be seen on scanning any patent register.

A good test of the quality of the inventions patented in any country should be the proportion of those applying to chemistry and the different branches of chemical industry and metallurgy, for the reason that there is no question of a "happy hit" in these departments of labour. Judged by this standard, the much-vaunted inventive genius of the people of the United States comes lamentably behind that of such an "effete" people as the Germans. It is, moreover, the characteristic of metallurgical and chemical inventions that they frequently form the bases of new industries that give employment to many people, and turn wasted matter into valuable merchandise.

One such invention as Bessemer steel, for instance, is worth any number of patent finger-nail cutters, hat-stretchers, or other petty devices of the notionists of two hemispheres.

If there is nothing admirable, useful, or instructive in the snap-shots at Fortune which crowd our patent registers and delude superficial observers into the belief that the people who originate them must be very clever, it is quite otherwise with invention that proceeds from competent knowledge, which is likely to redound to the advantage of the individual inventor and to the community. And what we have now specially to say to students who may blossom into inventors when their ideas become ripe, is that safe progress is best assured by looking backwards. Epimetheus, as Charles Kingsley would say, is a surer guide than Prometheus. The histories of all industries are full of records of old processes which can be read with instruction by every thoughtful worker, and must be studied with particular care by all who fancy themselves on the trail of something previously unknown. Authoritative treatises may or may not, according to the scope of the authors, contain the whole antecedents of a manufacturing process; but they can seldom be relied upon by the prospective inventor, for the reason that he is differently inspired from the writer of a general account of an industry. He needs light upon points which cannot be said to possess general interest, and often desires instruction respecting the exact causes of the failure of early processes, which the general historian records but cannot explain.

For this reason, students of gas engineering and chemistry may be recommended to search through old volumes of the JOURNAL whenever their minds are occupied with so-called novelties. These are a mine of half-forgotten information respecting proposals for overcoming difficulties that can hardly be said to be conquered yet, and which are consequently liable to be attacked in the same way over and over again. Old patent specifications and technical memoirs also not infrequently conceal projects which bear directly, and with startling relevancy, upon current questions. Who that followed the evidence in the great "Otto" gas-engine lawsuit, with the references to the alleged anticipation by Beau de Rochas, was not aroused for the time to respect the principles, if not the methods, of past unsuccessful and overlooked inventors? Quite recently, again, we have witnessed in the Bowman oxygen process the revival of a project that dates from Tessié du Motay, who was himself a fountain of applied chemical lore. It is upon such men that modern science and art rests, and there is a complete course of education in reviewing their suggestions and repeating their experiments. If Mr. Bowman should succeed in correcting the defects of an old process, as Messrs. Brin did before him, it will be another vindication of the Epimethean method of progress by looking backward.

Fervent young spirits are very apt to hear with impatience addresses on the text, "There is nothing new under the sun." A good deal is new in their eyes, and they chafe at the warning which assures them that the world is very old, and has forgotten a good many things more than they are ever likely to know. There are two ways of uttering this warning, however; the most common and likewise the most offensive method consisting in the assertion of the essential antiquity of novelties, as though this quality at the same time implied loss of value. "What is the good of trying that; it has been done over and over again years ago to no purpose." This is the disheartening method of warning. The other way is, when a sanguine spirit draws attention to the desirability of removing a particular obstacle in the path of progress, to recommend a critical study of what has been attempted to the same intent and has been unsuccessful. It is well understood that many old projects failed through having been launched before their time—when certain subsidiary, but indispensable features could not be properly rounded off. Recorded failures, moreover, were liable to be seized upon by writers of text-books and professors in colleges, and held up as frightful examples of ignorance or misapplication of certain fundamental principles only supposed to be perfectly comprehensible though the teachings of such writers and professors. In this way modern steam engineering has covered the distance between the motors of the *Great Eastern* and the *Teutonic* without help from text-books or professors. The main reason for this is that your authority, whether he be a writer or lecturer, is only too prone to think it would be derogatory to admit that he does not know everything, and that an unsuccessful experiment may have failed merely through being wrongly conducted. It is notorious that the influence of such books as "Box on Heat" and other professed interpreters of the experimental results of Péclet, Regnault, and their fellows, was a great hindrance to the popularization of the gas-furnace. These experimentalists taught, and rightly, that the useful effect of carbon burning to carbon dioxide is greatly superior to that of carbon burning to carbon monoxide, or the burning of the latter to carbon dioxide; but the principle of recuperation in furnaces had not entered the heads of any of these philosophers; and therefore it was that the measure of its practical importance was the measure of their imperfection.

Wherefore to the student we say: Look not only back over one year at the beginning of another; but direct your eyes farther back yet into the mist of time past. See what has been tried before your day; and perchance you may be privileged to pick up some dropped and quenched torch, and to re-light it successfully for the benefit of the nations in the future.

NOTES.

Compression Gasholders.

A means of dealing with a gasholder too light for its work is sometimes a *desideratum* with a gas manager. Many ingenious devices have been adopted for this purpose, from the simple expedient of loading the crown of the holder with fire-bricks and old iron, to others of a more scientific character. The height of neatness in this matter has apparently been reached by an American inventor, Mr. Frank Moore, of Pittsburgh, who has patented a compressing gasholder of a novel order. He proposes to lay girders across the top of a gasholder, presumably to keep the crown sheets from being lifted off, and to attach to the projecting ends of these girders screwed rods engaging in nuts fixed upon the tank, and capable of being revolved by steam or gas engine power. The effect would be precisely analogous to that of lowering a holder into the tank in the ordinary course of construction, with the difference that in this case the nuts and screws would actually pull down the holder to any depth of immersion, and consequent pressure, permitted by the depth of available seal. Mr. Moore's idea is to connect all his depressing screw-nuts by shafting driven by the single motor, the action of which could be controlled by an automatic governor actuated by the compressed gas, whereby the required pressure could be maintained. Apparently, the pressure girders can be elevated so as to clear the holder; and the vessel would then act in the ordinary way by its own weight. At any moment, however, a few revolutions of the engine would bring the compression arrangements to bear in the manner described.

The Direct Production of Light.

In a paper contributed to the *Revista Maritima*, Signor Giulio Bertolini gives a summary of the remarkable experiments of Professor Hertz on electrical undulations, which were designed to verify the suggested identity of light-waves with electrical oscillations of the ether. Faraday thought this might be true; and Maxwell was also led to conclude that electrical action is transmitted through space by means of oscillations of the same order as the luminous waves; the difference between the two phenomena depending only on the difference in the wave-lengths. Professor Hertz's experiments are now declared to have demonstrated: (1) That the medium which intervenes in the phenomena of electrical action is the same as that which is the seat of luminous phenomena; (2) that both species of perturbations are propagated under the same conditions, and with equal velocity; (3) that there is identity of nature between certain electrical and luminous phenomena. Moreover, it is stated that one of the greatest triumphs of Professor Hertz consists in having realized an arrangement whereby the length of the electrical wave is considerably diminished; thus approaching the character of the luminous wave, and shadowing forth a prospect of the direct industrial production of electric light. Indeed, different sources of artificial light can be compared by other than photometrical methods. Thus the lamps may be enclosed in an opaque calorimeter which measures the total energy of radiation W, and again in a transparent calorimeter which permits the light radiations to escape. The energy represented by the latter will then be measured by the difference between the two calorimetric determinations. Experiment has given the following results for the ratio of duty of different luminous sources which can be measured in this way as light; the total radiations being taken as unity: Candle, 0·00298; petroleum lamp, 0·00315; gaslight (kind not stated), 0·00317; oil lamp, 0·00442; incandescent electric lamp, 0·06; arc lamp, 0·1. Thus the electric arc lamp, which gives the highest duty of all, wastes nine-tenths of its energy in non-luminous, invisible heat rays. If these rays could only be quickened, they would appear as light; and Professor Hertz is in hopes of being able to do something towards this end by manipulating alternating currents. This memorandum should be read in connection with recent references in our columns to the work and opinions of Mr. Edison and Professor Nichols.

Heat Transmission in Boilers.

A contribution on the transmission of heat in boilers has recently appeared in the *Engineer*, from Mr. John G. Hudson, M. Inst. C.E., certain conclusions of which are of interest as specially bearing upon the question of firing boilers by gas. Mr. Hudson has passed in review a large number of the most trustworthy data obtainable for the elucidation of boiler performances; and he concludes: That as regards heating surfaces exposed to the fire, the transfer of heat takes place principally by radiation from the fuel and flame; that a large extent of fire-box surface in proportion to fuel burnt results in the absorption of a large proportion of the heat developed, but in a small absorption per unit of surface; and that an excessive air supply, by reducing the temperature of combustion, reduces the absorption. As regards surfaces exposed only to the gases of combustion, Mr. Hudson finds that they transfer their heat almost wholly by convection, the activity of which bears some proportion to the speed with which they traverse the absorbing surface—a transmission per degree directly proportioned to the square root of the speed being found to agree closely with actual results; and that the transmission per degree of difference is greater at high than at

low temperatures—a rate proportional to the mean between the absolute temperatures of the gases and the water being found to agree very nearly with obtained results. And, as regards all heating surfaces, it is declared that so long as the water, particularly if in the state of ebullition, touches them on one side, and assuming the metal to be solid throughout—*i.e.*, not laminated—the temperature of the hotter side, next the fire or the heating gases, can only exceed that of the water by an amount so trifling in relation to the whole difference that, for most practical purposes, it may be taken as identical with that of the water. According to these results it would seem to follow that the most suitable type of boiler for gas firing is the marine, with long cylindrical flues in which the gas can burn itself out with a luminous flame, being prevented by Seimens rings from touching the metal, and the products of combustion can be made to return with considerable velocity through comparatively small tubes.

COMMUNICATED ARTICLE.

THE CHEMISTRY OF ILLUMINATING GAS.

By Norton H. Humphrys, Assoc. M. Inst. C.E., F.C.S.

L.

PURIFICATION.

If the arrangements for condensation have been efficient, the gas at the outlet of the condenser will have been freed from all suspended matter, tarry or otherwise, and may safely be passed through the purifying apparatus without any risk of fouling it by the deposition of tarry substances. Should this not prove to be the case, the sooner a remedy is provided the better; for the presence of tar or oily matters in washers, scrubbers, and purifiers is a source not only of trouble (owing to the necessity of cleaning it out, to say nothing of the risk of increased pressure, or total stoppage) but also of loss by interference with the efficiency of the material, or by depreciation of the quality of the gas. In some cases the opinion that excessive scrubbing or washing is prejudicial to the illuminating power of the gas, may be traced to the fact that the apparatus is charged with tarry matters carried forward by reason of imperfect or of inefficient condensation; while in others it is due to the fact that the gas is subjected to a sudden reduction of temperature, by reason of the fluids used being considerably colder than the gas. In order to conduct the purification processes with efficiency and economy, we must first ensure that the gas is ready for purification—free from suspended matter and properly cooled. The breeze-box or dry scrubber, frequently used in gas-works some years ago, was really an apology for insufficient condensation.

The process of purification as usually practised in coal-gas works is directed to the removal of the sulphuretted hydrogen, carbonic acid, ammonia, and sulphur compounds, of which carbon bisulphide constitutes an important proportion. To effect this, the gas is first treated with ammoniacal liquor deposited in the foul main and condensers, next with clean water, and lastly with the solid materials. In all of these operations, the materials are exposed to the gas in an opposite direction, the gas passing first through the partly-fouled material, and lastly through that which is fresh and clean. In country towns, where there are no sulphur clauses in vogue, the purification is conducted without reference to the sulphur compounds, on account of the fact that to take these out means the previous removal of carbonic acid. So that we frequently find in small works, the time-honoured sugar of lead paper to be the only test applied systematically as a check on the purity of the gas supplied. When working according to the best methods, the gas is tested regularly for ammonia, carbonic acid, sulphuretted hydrogen, and sulphur compounds, and that not only qualitively, but quantitively. The lead or litmus paper merely indicates the presence or absence of a certain impurity; but this is not sufficient for accurate working. Without further information, one is simply going by rule-of-thumb. We must not only learn as to the existence or absence of impurities, but also as to the quantity present. Several methods of obtaining this information have already been described in the JOURNAL, and it is sufficient to mention the process suggested by Professor Vernon Harcourt, in which the quantities are arrived at colormetrically; the plan of absorbing the impurities in tared tubes packed with appropriate re-agents, explained by Mr. Lewis T. Wright;* Mr. John T. Sheard's carbonic acid test, in which a measured quantity of gas is aspirated through a specially-devised flask charged with baryta solution, and the contents subsequently titrated with hydrochloric acid; the one-tenth cubic foot bottles recommended and described by Professor Wanklyn, in which a standard solution of acetate of lead is used for sulphuretted hydrogen, and baryta water for carbonic acid—the result being arrived at either by titration, or by separating out and weighing the barium carbonate that is formed. Reference may also be made to the papers on "Volumetric Analysis for Gas Engineers"† and "Quantitative Purification,"‡ by the present writer, as showing that these tests can be made without a greater expenditure either of time or of skill than might be expected from the ordinary gas engineer. Numerous varieties of burettes—such as Bunte's, Hempel's, &c.—have repeatedly been described of late, and also several schemes for the complete analysis of gas. It is remarkable that, although it is possible to test for sulphuretted hydrogen and for carbonic acid in about a dozen different ways, the available tests for ammonia and for sulphur compounds are still limited to the apparatus described by the London Gas Referees some twenty years ago, in which the ammonia is absorbed in a glass tube packed with beads, and charged with an excess of standard acid, and the sulphur compounds determined by burning a known volume of gas in an atmosphere charged with ammonia, and collecting and subjecting the products to condensation. The sulphur compounds are absorbed and carried down by the moisture that condenses, and are estimated by precipitating with chloride of barium.

In order to have a clear idea of the manner in which the operations of purification are conducted, it is necessary in the first place to know exactly the proportion of each impurity that is present in the crude gas. The usual practice is to tacitly assume these as constant quantities, by gauging any apparatus as capable of purifying so many cubic feet of gas; but, as a matter of fact, the proportion of impurity is liable to variation from many causes. First there is, of course, the kind of coal used; and it is well known that the yield of sulphur, ammonia, &c., varies considerably in different descriptions of coal. But apart from these variations in the circumstances of distillation, the number of retorts in use, the heats, &c., have a great effect; so that it is not safe to assume, even if one sort of coal only is used, that the proportion of impurity to be dealt with will remain the same, one day with another. Starting with the foul gas in the hydraulic, a place for drawing off samples should be provided; and also at the outlet of the condenser, after each washer or scrubber, and at the outlet of each purifier. The gradual transit of the gas from the state of "crude" to that of "pure" can then be carefully watched.

The effect of increased make is considerably more marked than would follow from the larger quantity of gas to be dealt with. Separation of impurities always occurs to some extent in the hydraulic and foul main; but as the rapidity of output increases, the quantity so separated is reduced. With the maximum winter make, although the proportion of impurities at the outlet of the retort may remain constant, a larger percentage will pass forward to the outlet of the condenser. This point was strikingly illustrated in a paper read by the writer before The Gas Institute in 1889, when the daily make for an entire year, and also the proportion of sulphuretted hydrogen remaining to be removed from the gas at the inlet of the oxide purifiers, were graphically represented. In the winter there was not only a greater quantity of gas to be purified, but it also contained a considerably larger percentage of impurity, and that not because of any change in the percentage given off from the retort, but simply by reason of its being carried further forward. Anyone who has worked with purifiers that are really too small for the amount of gas passed through them, will have a fair idea of what this carrying-forward action is. A foul test is shown at the outlet of the vessel at a much earlier stage than would be the case with a larger box, and this not because the material is fouled completely; but on account of the gas passing so rapidly as not to admit of its complete saturation.

The utility of first removing the condensed water from the gas and then bringing it into further contact with the latter at a subsequent stage, may not be very apparent. It is based upon the facts that, in order for the water to exercise its fullest effect, both it and the gas must be cool—that is to say, at atmospheric temperature—and there must be an absence of suspended matters. The water which runs off from the hydraulic, foul main, and condenser, is certainly not pure, as it contains a very appreciable amount of impurities—notably of ammonia. But it has by no means exhausted its purifying capabilities, as may be well illustrated by warming a little ammoniacal liquor, when a noticeable quantity of ammonia and other impurities is given off. All the impurities are more or less soluble in water; but ammonia is more so than the rest, and hence the hydraulic-main liquor (notwithstanding the disadvantageous circumstances under which it is exposed to the gas) always absorbs a considerable quantity of ammonia. This property is a fortunate one for the gas maker, seeing that ammonia is a powerful base, and thus possesses the property of forming compounds with such of the other impurities as are possessed of acid properties. The pure water first seizes the ammonia, and thereby greatly increases its power of dealing with the other impurities. So the object of applying the condensed liquor to the gas is to get it thoroughly saturated.

The cost of removing sulphuretted hydrogen, by means of oxide of iron, is trifling, and, indeed, sometimes nothing at all. But the only known means of removing any carbonic acid remaining at the outlet from the last scrubber or washer is the use of lime, which is comparatively expensive. The application of the ammoniacal liquor is, therefore, conducted with a view to the removal of carbonic acid. Weak liquor appears to favour, if anything, the sulphuretted hydrogen. But in the stronger liquor, the well-known displacing action of carbonic acid comes in; and hence a larger proportion of the carbonic acid is absorbed. Therefore, the first treatment the gas from the condenser is subjected to, is intimate and sufficiently continued contact with liquor which has been charged as highly as possible with ammonia by repeated contact with previous portions of

* See JOURNAL, Vol. XXXIX., p. 422. † *Ibid.*, Vol. XLVI., p. 867, *et seq.* ‡ *Ibid.*, Vol. LVII., p. 550, *et seq.*

crude gas. Rightly or wrongly, a scrubber is usually employed for this purpose. After this it meets with weaker liquor, which may consist of liquor fresh from the hydraulic, or of water that is passed forward from the last stage. Here washers are generally introduced, and comprise a series of several different vessels, or else a combination in one vessel of several different compartments or chambers. After this the gas is washed with clean water, in order to remove the last traces of ammonia. The washing process may be rendered easier of comprehension by assuming it to be conducted in one vessel divided into (let us say) six chambers. The gas is admitted into No. 1, and passes forward consecutively, leaving at No. 6. The overflow of the liquids should be in the opposite direction; so that the outlet is at No. 1. Clean water is admitted at No. 6, and hydraulic liquor at No. 3. The clean water as it passes on to No. 5 is gradually charged with impurities and thus converted into weak ammoniacal liquor. Going on to No. 4, it acquires additional strength. Mixing with the hydraulic liquor, it forms a moderately strong solution; and this flowing forward to No. 2 and No. 1, is of sufficient strength to absorb carbonic acid in the first two chambers.

Seeing that the hydraulic and condenser liquor contains free ammonia, which in itself is a valuable purifying agent, some advantage is gained by applying it to the gas without admixture either with water or "washer" liquor. "Washer" liquor is so called in contradistinction to that which is actually deposited by condensation from the gas, and consists of added water that has become charged with impurities. The liquor contained in No. 4 in the arrangement above described is washer liquor; and it may be allowed to go direct to the store-well instead of passing forward to No. 3. When the liquor is utilized for sulphate making on the works, a strong liquor is not required. If the contents of the store-well average 5° or 6° Twaddel, it will be sufficient. It is quite possible to secure this, and not neglect the conditions above indicated—that the gas must come into contact with strong liquor first, and with clean water last. The hydraulic liquor, passed in to No. 3, should certainly escape at No. 1, not weaker than 10°. If it can be made stronger, so much the better for the removal of carbonic acid. Clean water may be passed in at No. 6 in sufficient proportion to admit of the overflow from No. 4, when mixed with that from No. 1, forming a store liquor of the strength desired.

Mr. F. C. Bell has retired from the Board of Directors and resigned the position of Managing Director of Bell's Asbestos Company, Limited.

Mr. Andrew Ross, of Cookstown (son of Mr. R. Ross, of the Dungannon Gas-Works), has been appointed General Foreman of the Iquique Gas-Works, Chili—a vacancy advertised in our issue of the 28th of October last year.

Society of Arts.—Among the papers to be read at this Society after the present recess, we notice one by Mr. W. Topley, F.R.S., on "The Sources of Petroleum;" and one by Mr. W. Robinson, on "The Use of Petroleum in Prime Motors."

Death of Mrs. Ashmore.—We regret to have to record the death of Mrs. Ashmore, wife of Mr. Ashmore, of the firm of Messrs. Ashmore, Benson, Pease, and Co., Limited, which took place a few weeks since at her residence at Stockton-on-Tees. The deceased lady was known to many gas engineers and managers, having been for a number of years a visitor at meetings of The Gas Institute.

Presentation to Mr. W. R. Herring, of Hastings.—On Monday evening last week, the officers and employees of the Hastings and St. Leonards Gas Company presented to Mr. Walter Ralph Herring a handsome marble dining-room clock and a pair of bronze statuettes (Shakspeare and Milton), on the occasion of his marriage. The presentation was made in the Board-room at the works by Mr. C. E. Botley, Assoc. M. Inst. C.E., the Company's Engineer and Manager, who, on behalf of himself and the subscribers (a list of whom, tastefully printed in colour, accompanied the gifts), expressed their good-will towards the recipient, and wished him every happiness. Mr. Herring suitably acknowledged the kind feeling displayed by his fellow-employees; and the proceedings closed.

Institution of Civil Engineers—Last Friday, this Institution reached its 73rd anniversary; having been founded on Jan. 2, 1818. The numbers of the various classes of members now on the books of this Institution are as follows: Members, 1700; associate members, 2880; associates, 427; honorary members, 19; and students, 927—together 5953. The present President is Sir John Coode, K.C.M.G.; and it is noteworthy that of the 27 distinguished men who have previously filled this position, 13 are still living. With a view to increase personal intercourse between the members of all classes, the Council have arranged for a series of receptions to be held after the ordinary meetings on Tuesdays, the 13th inst., Feb. 3, March 3, April 7, and May 5. It is thought that each gathering may be identified in some degree with a particular branch of engineering. This applies equally to those who attend and to the models and other objects of interest which, if possible, will be exhibited each evening. The paper to be read may also relate to a kindred subject. While this is the general idea, members are invited to contribute light, handy, and small objects for exhibition, or to suggest from whom such contributions may be obtained.

TECHNICAL RECORD.

THE VALUE OF A WATER-GAS PLANT AS AUXILIARY TO A COAL-GAS PLANT.

By A. B. Slater, of Providence (U.S.A.).

[A Paper read before the Society of Gas Lighting, New York.]

The condition of the gas coal supply during the past six months has brought prominently to our notice questions involving the uninterrupted supply of illuminating gas in all our cities and towns; and to such gas companies as still depend upon coal gas alone, the subject of this paper may perhaps have more importance at the present time than has heretofore been given to it.

Connected with all the great manufacturing industries of America, there is probably no one question or subject which demands more earnest attention, and calls for the exercise of sound judgment and wise counsel from the managers of industrial establishments than the "labour question." The Tariff and Free Trade problems excite widespread attention, not only throughout the United States but all over the world, and the effect of whatever action is taken by Congress reaches through all sections of the country and affects to a greater or less extent all our industries. But the "labour question" is, if possible, of still greater importance, because labour is the grand paramount motive power of civilization. Next to the supply of material for the manufacture of illuminating gas, is this same question of labour. If, from adverse conditions, the proprietors of most manufacturing concerns deem it wise to stop, they can do so; involving, as it does, simply a question of dollars and cents. But the gas companies must keep up their supply of gas at all times. When an electric light works stop their supply of light, as is quite often the fact, most of their customers fall back on their old surety—gas. It is very curious that, when the electric light fails, it is taken as a matter of course, as the customer rather expects it at times, and little is said about it. It is almost an unheard-of occurrence for a gas company to fail in its supply of gas; and should it occur, all the electric light companies could not supply one-half the demand for light to take the place of gas.

These two important factors—material and labour—enter prominently into the consideration of the question of supplementing a coal-gas plant with a water-gas plant. Never since the better class of American gas coal has been generally used has there been so short a supply in the market for so long a time; but we are just at present forcibly reminded that it is not easily obtained when the miners' labour ceases. The quantity of gas coal is practically inexhaustible; but without labour we cannot have it at our works. In the water-gas plant no gas coal is required, but in its stead hard coal is used; or, when more advantageous, coke may take its place. The question of labour, I think, has seldom affected the gas coal and anthracite regions at the same time; and, as it requires a much less quantity of hard coal to make the same quantity of gas, the chances of failing to obtain a supply are lessened.

For carburetting water gas, oil or naphtha is generally used, the supply of which, from past experience and present indications, can hardly be questioned; but if it should be a matter of debate with the over-cautious manager, while he is thinking and hesitating about it, the "other fellow" will get in his work, and take the advantage of it *now*.

With a stock of material in store, the next point we have to notice is the fact that the water-gas plant for the production of a given quantity of gas per 24 hours requires only about one-third the labour necessary to produce the same quantity of gas with the coal-gas plant.

While the judgment and intelligence of the foreman in the retort-house in a coal-gas works will be shown by the condition of his benches and retorts, as well as by the results obtained, lack of intelligence or carelessness in running the water-gas plant will much more visibly affect the results; so that it requires a more intelligent man to produce the best results with the water-gas plant.

Taking it for granted that we are possessed of a good apparatus or process, and have made a good quality of gas, the next question that arises is: What shall we do with it? That is to say, shall we mix the water gas with the coal gas, or shall we stop the coal-gas plant and distribute to our consumers simply water gas? Of course, the relative cost of gas coal, oil, or naphtha, and the income from the residuals from the coal-gas plant, are to be considered in determining this question—to the extent, that is, that dollars and cents may affect it.

Next to supplying the public with a gas of good and uniform illuminating power, is one of hardly less importance—viz., that of keeping the specific gravity of the gas as nearly uniform as possible. In fact, I have almost come to believe that a gas of high, but variable, illuminating power is not so satisfactory to the general consumer as a constant and uniform quality of gas, both as regards illuminating power and specific gravity, even though the illuminating power be several candles less. If our consumers have always been accustomed to a coal gas of 17½ or 18 candle power, and a specific gravity of ·420 to ·430, and we stop the coal-gas plant and send out water gas of even 3 or 4 candles better illuminating power, with a specific gravity

of (say) ·630 to ·670, the change is noticed in several ways. One of the first things we observe is that the new gas acts as a solvent for the greater or less accumulation of tarry matter collected in the pipes, joints, and cocks of old fittings; and the gas being of a more penetrating nature and of a more pungent odour, a small leakage is noticed at once, and having a different smell from the old gas with which the consumers are familiar, complaint is made that the gas "stinks." Again, where gas-stoves with atmospheric burners are in use, trouble is experienced at once, as the supply of air which was right for the proper combustion of coal gas is too much for water gas; and the air ports of the burners must be re-adjusted to enable them to work satisfactorily.

Then again complaint is made that the gas is poor—that is, the light is not satisfactory, even though the candle power is 3 or 4 candles better than the gas to which the consumers have been accustomed. Why is this? The light emitted from a gas-burner depends, first, upon the illuminating power of the gas, and, secondly, upon the area of the flame. We find that where the pipes, fittings, and burners are barely of sufficient capacity to give, under a certain pressure, a definite size of flame with coal gas of 17½ or 18 candle power and a specific gravity of ·420 to ·430, the water gas, although of 21 or 22 candle power and a specific gravity of ·630 to ·670, will not give a flame of so large an area, particularly where the capacity of the pipes is too small. Consequently, the gas is called poor. We also find that a mixture of (say) 70 or 75 per cent. of coal gas and 25 or 30 per cent. of water gas does not produce any condition or appearance that is noticeable by the consumers; but when the coal-gas works are stopped, and only water gas is sent out, it is not long before numerous complaints are made that the gas has a very bad odour, and that it gives a poor light—that two burners do not yield as good a light as one with the coal gas. At the same time the water gas shows from 3 to 4 candles higher illuminating power on the bar photometer at the office, which is about 1¼ miles from the works.

This condition of things continued with us for three or four months, when all at once (without any apparent cause, so far as we have been able to discover) the light became brilliant and the flame larger; and there was a general inquiry as to what we had been doing to make the gas so much better. We can imagine but one cause, and that is that the water gas had softened up or dissolved the tarry matter which had been collecting for years in the old pipes, fittings, &c., cleaned them out, and allowed the gas to reach the burners in nearly the same condition as it left the works. It is not impossible that one cause of the trouble was the imperfect conversion of the crude Lima oil which we used for carburetting the gas, although the accumulation of carbon in the carburetters, which was the cause of the imperfect conversion of the oil, was discovered and remedied some weeks before complaints began to come in.

The whims, caprice, and ignorance of consumers in regard to the proper use of gas, lead to magnifying any real cause for complaint. It was stated in the newspapers that the Gas Company were intending to supply water gas; and, long before the apparatus was put into operation, we had complaints that the new gas was poor, and that they did not like it so well as the old coal gas. After water gas was supplied, consumers who supposed they were using water gas, but who were really burning coal gas, said they would be satisfied if we would give them such gas as their friends had on the other side of the river, who were really being supplied with water gas.

After some ten months' experience in operating our water-gas plant, which is of the improved Lowe double-superheater type, and supplying both mixed gases and water gas alone, our conclusions may be stated as follows:

1. That to consumers who have long been accustomed to coal gas, a mixture of (say) 50 per cent. each of coal gas and water gas, properly made, is more satisfactory in all respects than either coal or water gas alone, for the reason that a higher illuminating power can be furnished with less liability to trouble from smoke; and the specific gravity being less than simple water gas, a larger flame, and consequently more light, is obtained, which is due to the larger area of the flame.

2. We are better fortified against trouble arising from a short supply of gas coal, particularly when caused by strikes of the miners. We can run our coal-gas works to better advantage, because we can keep the retorts constantly in use without the necessity of missing charges, and make up with the water-gas works any variable demand for gas that is made on account of dark weather or large consumption.

3. In case of any sudden labour trouble, if forced to do so, we can stop the coal-gas works, and keep the city supplied with gas with the water-gas works, and with one-third the labour necessary to run the coal-gas plant.

4. We are more independent of fluctuations in price or cost of material. We can take advantage of circumstances, and make more or less of coal or water gas, according as the cost of coal or oil and the income from residuals make it advantageous to do so.

5. The present unprecedented condition of the coal-gas supply has convinced us that we acted wisely in erecting the water-gas apparatus, even for that reason alone; and, with the view of putting our works in the best possible condition to serve our customers to the greatest advantage, and making still more sure the ability to do so, we are now constructing a water-gas plant at our other and larger station. When it is completed, we shall be able to furnish either coal or water gas, or (what I think we shall be more likely to do, so long as present conditions prevail) a mixture of about 50 per cent. of each gas.

THE ARTIFICIAL LIGHT OF THE FUTURE.

In the JOURNAL last week, we commented upon a paper, bearing the above title, recently read by Professor E. L. Nichols before the New York Electric Club. The following abstract of the paper is reproduced from the *Electrical Review*.

As we review the history of the electric light, we find that in two respects there is little cause for congratulation. When we come to consider the quality of the light produced and the efficiency of the apparatus as a light-making machine, we find that the incandescent lamp of to-day produces the same quality of light which the earliest examples of its type were capable of giving. It is true that the efficiency of the incandescent lamp has gradually risen from 5 to 3 watts per candle; but those who have had occasion to trace the discouraging life-curves of such lamps know how little real progress the change implies. We start a well-manufactured lamp at any temperature we please, provided that we do not pass a certain limit, beyond which the life of the lamp would be too seriously curtailed. The initial efficiency may be made as large as we please within that limit; but it is only a question of a few days or hours when the lamp will have dropped to the dead level of mediocrity—the 5-watt level, which seems to mark the confines of permanency in the case of incandescent carbon.

In some experiments made by me, in the first instance a lamp was started at the candle power indicated by the maker, and was held at constant voltage by means of the current from a storeage battery. The initial candle power was 16, which was obtained at the expenditure of 3·015 watts per candle. Measurements of electro-motive force and current were made at intervals of about 10 hours during the 800 hours that the lamp lasted. The candle power was re-determined at intervals of about 100 hours. The voltage never rose more than 0·65 volt above its initial value, and then only for a short time. The average electro-motive force of the entire run was 0·40 volt below the initial value. The characteristic features were rapid, followed by slower falling off in candle power; the decrement amounting finally to more than 50 per cent., and rapid, followed by slower, falling of efficiency, to a final value of 5·75 watts per candle. These changes were accompanied by continuous and marked increase in the resistance of the filament.

If it be asked whether this individual case represents a state of affairs common to all incandescent lamps, I can only say that in my experience, which is certainly much less extensive than that of some others, I have known of no class of lamps the performance of which did not agree approximately with the latter results. Mr. W. H. Pierce, who described extended tests of the initial and average efficiency of incandescent lamps in a paper read before the American Institute of Electrical Engineers some time ago, recorded no exceptions to this rule of decreasing candle power and efficiency with time.

This falling off in candle power exhibited by lamps maintained at constant voltage can be met by a procedure not easily applicable, perhaps, in commercial work, but readily carried out where the object in view is simply to study the behaviour of the lamp under unusual conditions. The method consists in raising the electro-motive force at short intervals of time by amounts sufficient to restore the candle power to its normal value.

The results of such an experiment performed upon a lamp showed that under this treatment its life was not quite 100 hours. The total rise in electro-motive force during the test amounted to about 9 volts; the efficiency decreased from 3·118 to 3·468 watts per candle. The resistance of the filament rose from 221·6 to 234·8 ohms. During the first 50 hours the changes were slight; then occurred a sudden increase of resistance, accompanied by a marked rise in the electro-motive force and in the amount of energy consumed. The life-history of the incandescent lamp at still higher temperature does not differ essentially from that which we have just been considering; but the changes in question go on much more rapidly.

In another experiment, a lamp was started at 57 candles. It was maintained at constant voltage for 11 hrs. 30 min., when it went out. During its brief life the candle power fell to 24·6, and the watts per candle increased from 1·58 to 3·09. The loss of candle power during the experiment was 55 per cent.—an amount which corresponds very closely with the loss suffered by the first lamp tested during the 800 hours it lasted. In the case of another lamp, the initial candle power (64 candles) was maintained throughout. Its life under these circumstances was 140 minutes, during which short period it had been found necessary to raise the electro-motive force from 114·08 volts to 129·53 volts. The efficiency of the lamp fell, in the meantime, from an initial value of 1·33 to 1·677 watts at the end of the first hour; then more and more rapidly to 1·945 watts at the end of the test.

The conclusion arrived at from these data, and from the great mass of experimental results which has accumulated since the incandescent lamp has become an object of investigation is only too evident. The efficiency of an illuminant in which carbon is the glowing material is a function of the temperature. It appears that

the incandescent lamp is fairly stable only at temperatures for which its efficiency does not exceed about 5 watts per candle. We have just seen what occurs when one attempts to maintain lamps at degrees of incandescence corresponding to a much higher temperature. It is, perhaps, not possible to point out with perfect definiteness all the causes that are at work to reduce the candle-power. The black coating which gradually forms on the interior of the lamp-bulb intercepts more and more the light from the filament as the age of the lamp increases. With regard to the absorbing power of this film, it was found that this was very nearly uniform throughout the spectrum, so that the blackening of the lamp had no appreciable effect upon the light which it emitted; also, that the absorption at the end of 200 hours was considerably more than half as great as that at the end of 800 hours, and that the total loss of candle power due to blackening was about 22 per cent.

These measurements enable us to account for rather more than one-third of the loss of candle power suffered by the lamp. We are not, with our present knowledge, in a position to speak so definitely concerning the other two-thirds; but the increase in the resistance in the carbon indicates another source of diminution. That gradual failure of the vacuum which the use of the spark coil would unquestionably have enabled the observers to detect, may well be answerable for the rest.

Now, the temperature of an incandescent lamp filament at 5 watts per candle is very nearly the same as that of the carbon in the light-giving flames produced by the combustion of oils and gas; and it appears that the attempt to pass this temperature introduces difficulties of such a nature as to lead to the serious question whether we have not reached a definite limit, beyond which incandescent carbon ceases to be permanent. At that limit the efficiency of the lamp is very small indeed; 95 per cent. or more of the radiant energy emitted being of wave-lengths too long to afford light.

As to the arc light, no more encouraging report can be made. On the contrary, it is perfectly well established that the quality of the light, instead of increasing, has fallen off, in the course of the development of the lamp from the clock-work regulators of Dubosc and Foucault, with their slender carbons, to the commercial lamps of to-day.

In the vast accumulation of experience which the past years have witnessed, nothing has come to general knowledge which looks to the raising of the barrier which blocks our progress. It seems only too probable that the limiting temperature at which carbon can be used for the production of light has been reached, and with it the maximum efficiency of artificial illumination.

What is to be the light of the future? From the standpoint of the engineer, I will frankly say that I cannot answer that question; but, abandoning the directly practical point of view, there is something to be said. I need offer no apology here for presenting facts, the application of which is at best remote, and the present importance of which is therefore rather scientific than utilitarian; nor need I remind you that all the so-called forces of Nature which have been yoked and impressed into the service of man, were the object of scientific curiosity, and the subject of scientific investigation long before the idea of a practical application was entertained.

The number of elements and of compounds capable of sustaining a high temperature without dissociation or change of state is very large. Carbon is the only one of these the capabilities of which as a source of light can be said to have been fully tested; and yet all the others, when heated to a proper point, emit light-giving radiation. Take as an example the metallic oxides. We heat the oxide of calcium in our magic lanterns; and it gives to us a light of very great intensity, and but little inferior to the arc light in whiteness. The exceeding clumsiness of our method of rendering it incandescent, however, has prevented its adoption, excepting for certain special purposes. We burn magnesium in fireworks and for photographic flash lights; and occasionally we indulge in the luxury of igniting a bit of the ribbon, and admiring, for an instant, the intense brilliancy of its flame. Now, magnesium is one of the most abundant elements on the face of our planet. It is a rather costly metal at present; being quoted at 50 c. an ounce in America, and at about half that price on the Continent of Europe. Even under the limited demand for it which exists at present, it has fallen to about one-tenth of its price a few years ago; and I feel sure that it lies within the power of the electrician to further greatly reduce the cost of production. Among artificial illuminants, magnesium has in one respect no equal. W. H. Pickering, who studied its spectrum in 1880, found it to approach sunlight in quality even more closely than the electric arc light does. Weight for weight, magnesium affords more than 30 times the light obtained from gas, with the development of much less heat. The quality of the light is such that merely from the standpoint of illuminating power, to say nothing of the additional æsthetic value of a light approaching sunlight in whiteness, each unit of it must be regarded as the equivalent of rather more than 1·25 units of light.

The study of the radiation of the metallic oxides above the red heat reveals the existence of properties which lead us to regard them as being luminescent "by heat." It is from such bodies that radiation of high efficiency is to be looked for. We have in magnesium oxide a member of this particular class; and when it is heated in the process of formation, it gives us a light unapproached by that of other artificial illuminants.

The problem is easily stated: (1) We need a body which is rendered vividly luminescent by heat. The metallic oxides would seem to offer us many such. (2) The material is to be brought to the temperature at which its luminescence is most marked. Does it not seem probable that the best method, as in the case of carbon, will not be that of direct combustion, but of heating through the agency of the electric current? (3) The material must be restored from time to time. Whether rejuvenation is to be secured through electrical, chemical, actinic, or mechanical means remains to be determined.

Luminescence "by heat" offers, however, only a partial solution of the problem of the highest efficiency. However great the efficiency of the luminescent itself, it is accompanied by incandescence of the ordinary kind. The ultimate solution is to be sought for along other lines. Incandescence is too expensive a means of exciting luminescence. There are many other ways in which it may be generated—friction, chemical action, the impact of light waves, electrical excitation, certain vital processes, are known to result in the production of light. The physics of these phenomena is, for the most part, undeveloped. I know of but two attempts to determine the efficiency of this "light without heat," as it has sometimes been called. The intensity is, as a rule, very small; and the heat has doubtless been regarded as quite below the range of even our most sensitive apparatus. One of these two cases is of especial interest to the electrician. It is that of the spark discharged *in vacuo*. Professor S. P. Langley and Mr. F. W. Very, in a recent remarkable paper, entitled "The Cheapest Form of Light," speak of the heat generated in the Geissler tube as so minute as to seem to defy direct investigation. It has, however, been successfully measured by Dr. Staub, of the University of Zurich, by means of one of the most delicate instruments devised for the measurement of heat—the Bunsen ice calorimeter. In Staub's experiments, the vacuum tube was smoked with lampblack and inserted in the ice calorimeter. The ice melted in a given time afforded a measure of the total heat generated by the electric discharge through the tube. A repetition of the determination with the unsmoked tube, under which conditions the light-giving rays could escape, gave the energy of the non-luminous radiation. The efficiency was found to be 3·268 per cent. The extremely small candle power of light derived from the electric discharge *in vacuo*, may seem to preclude all questions of its utilization in practical illumination. The result is one, however, which should not be lost sight of. It suggests a field of investigation which may prove unexpectedly fruitful.

The Geissler tube effect was not the source to which Langley and Very applied the term "the cheapest form of light." The subject of their research was the light of a Cuban fire-fly. Their work cannot fail to excite the highest admiration of everyone who is able to appreciate the difficulties of such an investigation. The exploration of the heat spectrum of so insignificant a source of light is a task which very few physicists would, I think, have considered practicable; but it has been carried through by these investigators with complete success. When we study the curve of distribution of energy in the spectrum of the fire-fly thus obtained, and compare it with the corresponding curves for gas light, the arc light and sun light, we find the expression, "the cheapest form of light," which is applied to the light of the fire-fly by Langley and Very, to be fully justified. All the energy of its spectrum is massed within the narrow limits of the visible spectrum, and what is more, by far the greatest part of it is in the form of rays which are especially important for the purposes of radiation—the particular rays which give us yellow and green light. The non-luminous radiation which accompanies the light of the fire-fly seems to be so insignificant that it was with difficulty that it could be estimated, even with the almost inconceivably delicate apparatus used by Langley and Very. They give the efficiency as about 400 times as great as that of a gas-flame. It cannot fall appreciably below 100 per cent.

I have endeavoured to show that the efficiency of our present methods is too low to meet the demands of the future for economical illumination, and that whether we ever succeed in approaching the perfect economy of Nature's light-making processes, as exemplified in the fire-fly, or not, there are many sources of light which promise high efficiency.

Combined Gas and Electric Light Undertakings in Massachusetts.—A short time ago the Worcester (Mass.) Gas Company and the Worcester Electric Light Company entered into an agreement to amalgamate their undertakings; and they petitioned the Board of Gas and Electric Light Commissioners of the State for their sanction to the arrangement. This, however, after careful investigation by the Board, has been withheld; the Commissioners being of opinion that it will be for the best interests of all concerned—both consumers and shareholders—that the proposed consolidation should not take place. They say they see no valid reason why, pursuing their separate courses, the two Companies will not be able to supply their customers as satisfactorily as they would under the new conditions proposed. The decision must have caused some little surprise to the parties interested, as the proprietors of both undertakings were practically unanimous in the belief that their mutual interests would be better served by a union than by working separately, and that the electrical division of the business could be conducted with greater economy.

THE GAS COALS OF THE UNITED STATES.

By H. C. Adams, of Philadelphia.

[A Paper read before the American Gaslight Association.]

(*Continued from Vol.* LVI., p. 1344.)

In West Virginia we find the remaining two of the three principal gas-coal regions of this country. In the north-eastern part of the State lies the "West Virginia Gas Coal" region, as it is commercially known; and in the south-west lies the great Kanawha field. This State is blessed above all of her sister States, with few exceptions, in the richness and extent of her mineral deposits. Steam, gas, splint, and cannel coals all abound within her borders. On every side is coal of one or another quality to be found. Of the fifty-four counties in the State, only six lack workable coal-beds.

The coal measures of West Virginia are of the same general system as those described in Pennsylvania, of which they are an extension. In the northern part of the State we find the Pittsburgh bed; and in the southern part, the lower measures furnish the various seams. So far as gas coal is concerned, we may make two great divisions—(1) the West Virginia region, lying in the Monongahela Valley; (2) the Kanawha region, lying in the valley of the great Kanawha. To the first of these we will now turn our attention. The same river, the Monongahela, almost synonymous with coal, along whose banks in Pennsylvania we found gas coal lying in such abundance, crossing the Pennsylvania State line flows southward, forking out to the south-east and south-west, through the north-eastern part of West Virginia, and, cutting down through the superimposed strata, exposes the Pittsburgh seam again along its course through Monongahela, Marion, Taylor, and Harrison Counties, and defines the gas-coal region. Through this broad valley runs the Baltimore and Ohio Railroad, the outlet of this region to the various markets east and west. To the eastward the coals pass along the Baltimore and Ohio rails to Baltimore, where they are transhipped into vessels and carried to the gas companies of the Atlantic seaboard; and in this direction the greater part of the tonnage is carried. Outlet is had to the north-west and to the lakes at Cleveland by way of Wheeling; and to the west and south by way of the Parkersburg branch to the Ohio River. Grafton, in Taylor County, represents the railroad centre of the region; and from this radiate the various branches of the Baltimore and Ohio line, carrying the coals to the markets above described. These coals appeared in the markets early in the history of gas making in America, and were among the first United States coals carbonized. In the early fifties, the shipment of them to New York, Philadelphia, Boston, and Baltimore was begun; and, in spite of the competition of the other and more newly-developed regions, it is still maintained. Owing to the fact that many of the operators coke their screenings, large-sized screens are found among these mines; in fact, they run from ¾-inch to 3-inch apertures. This should make the proper cleaning of the coal an easy matter, and more than compensate for the lesser density of the coals, and their greater liability to loss from attrition than Pennsylvania coals when carried to market.

The Pittsburgh seam, which underlies the whole north-western half of the State, and which is found again in the eastern-most counties and across the Maryland State line as the famous big vein Cumberland coal, is the sole source of gas coal in the West Virginia region. While it is mined along the Ohio River on the western border of the State, and in other parts, it is nowhere of the sufficiently strongly marked "gas" character as in this district. We may name Monongalia, Preston, Taylor, Harrison, and Marion Counties as defining the gas-coal area. There are no gas-coal operations east of Newburg, which lies close to the eastern crop of the seam, nor west of Wilsonsburg, beyond which point the vein sinks, to rise again as it approaches the Ohio River. The coal measures here lie in the parallel north-east and south-west basins, which we found characteristic of the Pennsylvania coal measures. The light dip of the coal in the wide basins, and the general parallelism of the strata, render mining easy. The coal is everywhere within easy reach in the Monongahela Valley. At Newburg, on the east, it is found in the hill-tops; at Fairmount and Gaston, it has fallen to the level of the railroad. So accessible is it that there is only one shaft in the entire district. Fairmount, in Marion County, may fairly represent the centre of this region. As we go thence down the Monongahela, we find the quality of the coal deteriorating, and becoming more impure and sulphurous. Following the valley to the south, below Clarksburg, the seam thins out, and the coal falls in value. At Clarksburg and Fairmount, and between these two points, the coal is a magnificent seam, running from 8 to 10 feet of clean coal. The entire section of the seam here is 15 feet. The first 4 feet comprise an intermixed shale coal and slate roof division; then comes the main bench—say, 9 feet of good clean coal; then, below a small 3-inch parting, comes an 18-inch bottom bench of poor slaty coal. The whole 9 feet of coal is taken out; being undercut at the bottom. Such a splendid breast of coal should afford an opportunity for bringing out coal in first-class condition, with little labour and expense. This main bench of coal is generally clean and free from slates, though they occasionally occur near the top. In density the coal is nearly equal to the Pittsburgh coals of Pennsylvania. It has a clear, sharp, cubical cleavage and conchoidal fracture. The cleavage, however, is at times seen as slaty or splint-like; bringing out the coal in long slabs instead of the familiar cubes. The lustre of the coal is bright and resinous. It has, in fact, the same general characteristic as the Pennsylvania coals. Through its lesser density, it does not bear transportation so well; and it has a tendency to slack in re-handling and transhipment, which, of course, reduces its value for gasification at the point of delivery. Further, it is highly pyritous; in fact, the chief inferiority of this coal to the Pennsylvania coal is in its greater sulphurousness. All through the region it is impregnated with this impurity, which runs extremely high towards the limits of the gas-coal area, and which really to a large extent defines it.

The two mining centres are Fairmount, in Marion County, and Clarksburg, in Harrison County; and around these two towns are grouped the principal mines of the district. While the general characteristics of the coals in these two districts are the same, yet, generally speaking, the coal near Clarksburg is likely to be more sulphurous than that around Fairmount. Locally, the coals of the West Virginia region vary to such an extent that it is difficult to give a general statement as to their chemical composition. An average of a number of analyses of the standard coals gives the following approximate determination:—

Volatile matter	35 to 40 per cent.
Fixed carbon	53 to 57 ,,
Sulphur	1 ,,
Ash	4 to 7 ,,

In gasification, this coal, owing to its high percentage of sulphur, is rarely used "straight;" but generally in a mixture with other less sulphurous coals.

No mention of the gas-coal districts of West Virginia would be complete without reference to the once famous Ritchie mineral—a species of asphalte that was found in a vein 4½ feet thick vertically, extending over a small area in Ritchie County. This "pocket" (as such small isolated deposits are generally called) was soon exhausted, and the supply ceased. The deposit closely resembled the Albertite of the Province of New Brunswick; and, like it, proved of great value as an enricher of coal gas. It analyzed 55 per cent. of volatile matter, 42 per cent. of carbon; and only 3 per cent. of ash. It gave from 26 to 28 bushels of fair coke per ton carbonized—a favourable comparison with the best cannels of to-day.

Passing on to the south-west, we come into the great coal-field of the Kanawha Valley. The containing measures here are the equivalents of the Lower Productive—*i.e.*, the Freeport and Kittaning veins of the Pennsylvania series—and are of great thickness and commercial value. The Pittsburgh seam, which has heretofore furnished the principal field for our inquiries, does not enter to any considerable extent the field of the Kanawha Valley operations. Its outcrop or limit passes south-westward through almost the centre of the State, strikes the Kanawha River near the western boundary of Kanawha County, passes on down into Campbell County, and turns thence north-westward into Ohio. And, while it is worked at points along the Kanawha River between Kanawha County and its junction with the Ohio, it is so small a factor, comparatively with the enormous developments in the lower measures farther up the river, that it deserves mention only as defining the southernmost limit of that famous seam.

The Kanawha River, which defines the important region to which it gives its name, has its head waters in North Carolina; thence they flow northward across the western half of the State of Virginia, and, entering West Virginia near the point where Mercer, Summers, and Monroe Counties join on the State line, flow north-west, across the southern half of the State, to Point Pleasant, where they meet the Ohio River. The Kanawha proper extends only from the Ohio to its junction with the Gauley River, near Kanawha Falls. Above that it is known as the New River. The river system has been described at length because it so clearly marks the scene of operations in the coals; and, roughly speaking, its divisions likewise divide the grades of coal for our purposes.

The New and Kanawha rivers have really no valleys, in the sense of broad areas of level country, contiguous to their course. They run in a deep and narrow canon, which they have worn down through the Lower Productive measures; exposing the various coal seams at successive levels along their precipitous banks. We find here the characteristic of the Pittsburgh seam met with in our researches through its course to the north-east of this region—*i.e.*, the gas coals on the west, and the stream and coking coals on the eastern side of the field. Along the New River lie the great fields of steam coals to which that stream has given name; while on the Kanawha proper, from Kanawha Falls to Charlestown, and extending (say) 30 miles north and south of the river, we find the gas-coal region, or the area of the best gas coals. From Kanawha Falls westward, these veins lie above water-level; but near Charlestown, as they approach the Pittsburgh seam, they sink, and pass below water-level, and out of the reach of commercial operations.

There are exposed in that district four or five seams of coal along the river bank. The lower one lying, to take a typical section, some 20 feet above the river level, and containing from 4 to 4 ft. 6 in. of good bituminous coal. Then next above—perhaps 100 feet above—comes the second seam 6 ft. 7 in. thick, containing the gas coal. Farther on, at 500 or 600 feet elevation, is found a vein of splint coal, about 100 feet above which, in a splint seam some 6 feet thick, comes in the famous cannel of this region. Capping all, about 800 feet above the river, is found a seam of some 6 feet of block coal. Thus, taking a fair

example of the river bank, we see an extraordinary exhibit of seam upon seam of coals of different, but all of good quality, exposed at accessible points, and all of workable thickness.

The moderate dip of the measures to the north-west, 40 to 60 feet to the mile, permits of easy and cheap mining. When brought out, the coal is lowered to the river on inclined planes, and there tipped into boats or cars, as may be desired. The gas-coal seam, which is known as seam No. 2, runs from 4 to 7 feet in thickness, is made of three benches with clay partings, and with seams of splint from 4 to 14 inches thick, interstratified. The coal itself is clean, with a clear black, resinous lustre, of cubical cleavage and conchoidal fracture. Its density is not quite so great as that of the Pennsylvania gas coals; and it consequently suffers more than they do from the attrition of transhipment. Its general preparation for market is the same as that of Pennsylvania coals, save that it is screened over 1½ inch screens to increase its lumpiness; and it is also more highly sulphurous. With these two exceptions, it is quite the peer of the Pittsburgh coal; giving a large yield of high-candle gas, and having a very low percentage of ash. This region possesses valuable facilities for shipment to the markets of the East, West, and South. The United States Government have built a very extensive and complete system of free slack-water navigation on the Kanawha River, similar to that described in the Monongahela; and by means thereof the Kanawha coals are shipped by water at very low rates to points along the Ohio and Mississippi Valleys, where they have become large and dangerous competitors of the Pittsburgh shippers. The only rail carrier of these coals from the mines is the Chesapeake and Ohio Railroad, which takes them to the markets of the West and North-West by way of Point Pleasant. To the Eastern market they are carried by rail to Newport News, where extensive shipping piers are erected, and shipped thence by vessels to the various gas companies of the Atlantic seaboard, where they are no inconsiderable factor in the gas-coal market, which they first entered about the year 1876. They are, however, owing to their general high percentage of sulphur compared with the Pennsylvania coals, for the most part used in admixture with the latter, and in only a few instances are they carbonized "straight."

Analyses of the product of some of the various gas-coal mines in this region show the following percentages:—

Volatile matter	35·10	..	40·42	..	34·91	..	33·92	..	37·357
Carbon	64·90	..	56·00	..	61·75	..	61·96	..	56·257
Sulphur	1·48	..	*	..	*	..	0·65	..	1·286
Ash	2·00	..	3·00	..	2·40	..	2·35	..	3·850
Water	—	..	0·50	..	*	..	1·12	..	1·250

*Not given.

Valuable deposits of cannel coal occur in this region, the chief of which is in the neighbourhood of the town of Cannelton. These deposits are, as usual, in the form of "pockets" of limited area, and generally referable to seam No. 4, or the supposed equivalent of the Upper Freeport seam of Pennsylvania. The cannel is found interstratified with splint or bituminous coal, and of varying thickness, though at Cannelton it gives 3½ feet. These cannels are of the usual dull gray slate colour, and lie in the vein in layers, with a well-defined parting. Owing to their density and position, they are expensive to mine. They are extremely hard, and difficult to break in the vertical plane. Horizontally, they break with greater readiness, showing conchoidal fracture. Originally, this coal was mined for distillation for oil; but about 1873 it was brought into the market as a gas enricher, where it has since held a position as one of the standards. There are in this region, no doubt, many valuable deposits of cannel as yet undiscovered, which further development of the coal-field will bring, literally and liberally speaking, "to light." At present, the extensive use of oil as an enricher of gas, curtailing as it does the use of cannel, does not stimulate investigation of the available area and supply of this grade of coal.

In analysis, this cannel yields as follows:—

Volatile matter	43·100 and 58·00 per cent.
Carbon	56·900 „ 23·50 „
Ash	7·400 „ 18·50 „
Sulphur	1·162 (not given)

Mr. E. V. D'Invilliers, in his early and extensive investigations in the great Flat Top region about Pocahontas, suggested the likelihood of the same conditions prevailing in that region, in regard to the relative qualities of the coals in the wide area extending thence westward through Virginia, and north-westward through West Virginia and Kentucky along their mutual boundary-line, as we find in the Pennsylvania and also in the Kanawha fields—that is to say, a gradual increase in volatile matter as we pass to the west and north-west. Hence we should expect to find gas coals, or coals of approximate character, as we pass to the west and north-west along the line indicated through the Quinnimont (the conglomerates of Pennsylvania) series of coal measures, as they are termed in this region. Very recent research on an extended scale along the proposed Ohio extension of the Norfolk and Western Railroad, north-west from Pocahontas, Va., to the Ohio River, through Martin County, Ky., and Wayne and Logan Counties in West Virginia, has justified that inference. Coals have been disclosed, high in volatile matter, and, so far as analyses and physical characteristics go, suggestive of valuable gas coals. They have not yet, however, been subjected to test in gasification; so that al lthat can be said is that it is likely this district contains a large area of good gas coal. As we found the West Virginia field lying south-west of the Pennsylvania coals, and the Kanawha field south-west of the West Virginia, so we find the district now in question lying in a continuation of that south-west line through the Kanawha field.

Investigations pursued in the south-eastern end of the field in the valleys of Coal Creek in Tazewell County, Va., and in adjacent districts along the Clinch Valley Division of the Norfolk and Western Railroad, show that of the three seams generally exposed, one exhibits indications of a good gas coal, in a seam likely to average 3 feet clean. The analyses of samples indicate a good coal; and, so far, tests on a small scale have borne out the prophecies of the analyses. The working has not, however, as yet been of sufficiently extended character to warrant a positive statement as to the qualities for gasification. The most important question yet to be determined is whether the seam will run, on an average, sufficiently thick and clean to enable it to be mined readily and profitably. This only further development can decide. I understand that active operations towards that end are to be undertaken at once.

Turning aside for a moment form our south-westerly course, we find in the vicinity of Richmond, Va., a small but interesting deposit of coal, running from a high bituminous to a natural coke—*i.e.*, where the igneous action has been more rapid than in the case of anthracite, and a less perfect result attained in carbonization. These deposits were of a much later period of continental life than the coal-fields of the western part of the State, and are believed to have been formed in what is known as the Triassic Age. The deposits of the bituminous coals are in places extremely thick; running as high as 40 feet. The best presents the following analyses:—

	Clover Hill.		Midlothian.
Ash	10·132	..	14·73
Water	1·339	..	2·55
Volatile matter	30·984	..	29·73
Carbon	56·831	..	53·01
Sulphur	0·514	..	0·58

While these analyses make a good showing, yet in actual practice the coal as shipped to market is so highly charged with sulphur, and carries with it so large a percentage of ash, as to make it practically of small value in gasification in the presence of the superior grades of gas coal found in the markets to which it could be shipped. These Triassic coals have been used on a small scale in gas making; but in the short time at my command, no recent record of its working could be obtained. Little work has been done in this field for very many years. There are also in North Carolina two small areas of Triassic coal. Little work has been done in these fields, likewise, of late years; but some of the coal, from what is known as the Deep River field, has been used in gasification, with results said to be satisfactory. But of this no record could be had.

The coal-fields of Kentucky are of two principal divisions—the eastern and the western. The eastern is of the Appalachian system of coals, and is an extension of the Kanawha and West Virginia and South-West Virginia deposits, and covers the eastern half of the State. The western division is an extension of the great middle or Illinois coal-fields. Kentucky, in her eastern counties, is rich in coal veins. Her coal measures are tilted over at an inclination that exposes successfully their whole section. A dozen or more seams are found, all persistent and recognizable, in different and distant localities. She has been blessed, however, rather with number than excellence. Of the whole ten principal veins of coal, none is of such uniform thickness as to make it of great commercial value. At times they show workable thickness of excellent coals; but the seams vary to such an extent, both in sections and in physical quality, that little dependence can be placed upon them. It is unlikely that they will be extensively developed while in the adjacent States thick veins are accessible. As in number of seams, so in variety of coal. We find here nearly everything but anthracite. The principal formations, however, are splint or black coal and free-burning, non-coking bituminous coal. Good coking coals are found; but gas coals are a rarity; and where they are discovered, none are of such generous formation as to make it likely they will ever be a considerable factor in the market, though analyses of local coals show excellent chemical compositions. The comments made upon the eastern coal-field will serve as well for the western field, so far as its general characteristics and its status as a producer of gas coal are concerned. The various seams, running from shale or bituminous coals to cannel, have made numerous and underspread deposits of the latter. It can be found in one or the other of the several seams, in different quantities and of varying quality, nearly everywhere in the area underlaid by these coals. At times and in certain localities, it attains an excellence of quality and a magnitude of area that have made it a commercial possibility; and it is from this State that the majority of our best known and most desirable cannels come. To these we will now turn our attention.

Of Kentucky it may be said that no other State has so large an area of rich and thick cannels. They are found in both the eastern and western fields, and of good quality in nearly every county in the State underlaid by coal. The best cannels of the eastern field are generally found on what is known as seam No. 4 of the upper coals; but it is impracticable to relegate the best cannels in either field to a particular seam, so difficult is the determination of their equivalency. The cannels are found here, as elsewhere, in detached basins, in pockets of variable extent in area, and of no uniformity of thickness; hence, any

estimate of their area in any locality is largely conjectural. The vein is generally very thin—running from 18 inches to 3 feet; and it is composed of superimposed thick lamina, like slabs of slate placed one upon the other, underlaid by inferior shale or bituminous coal or clays. Through these underlying strata the "bearing in," or undercutting, is done. The mining is generally very difficult and expensive. The colour is the familiar dull slaty grey, with, at times, highly polished fracture, which is always conchoidal. The coal is remarkably dense and tough, and strongly resists cross fracture; while it parts with comparative ease horizontally in the line of the lamina. These physical characteristics give it, of course, a structure that resists the rough handling of transportation, and admits of its being carried the longest distance in good condition. The chief carrier through the State is the Chesapeake and Ohio Railroad, though those coals along the Ohio River are loaded on barges and shipped along that great water-way to the Southern and Western markets. In some instances these cannels were first developed for the distillation of oil prior to the discovery of the large fields of free natural oil; as many as 120 gallons of oil being distilled, it is said, from a ton of the best of these coals. In the eastern field, Greenup, Carter, Boyd, and Johnson Counties are the principal producers of cannels; though in the centre of the field, about the head waters of the Kentucky River, in Breathitt and adjacent counties, excellent deposits are discovered. In the western field, Hancock and Breckenridge Counties are the chief producers; and they are famous the world over for the excellence of their coal.

The analyses submitted below will show the comparative composition of these coals in the various localities:—

	Pike County.		Breathitt County.	
Volatile matter	43·400	68·28	53·80	58·80
Carbon	46·300	29·73	45·00	35·30
Sulphur	0·689	0·83	0·722	4·07
Ash	8·300	3·64	5·54	—

	Perry County.	Hancock and Breckenridge Counties.	Greenup County.
Volatile matter	44·160	60·90 to 77·50	47·46
Carbon	49·400	27·00 „ 21·05	38·84
Sulphur	0·766	1·89	12·40
Ash	6·000	12·10	1·55

These analyses will serve, in a very general way, to show the range of quality and the general characteristics of the coals. In coking, they vary greatly; some producing a good merchantable quality, that may be readily mixed and sold with that of coking coals; while others—and these the majority—make a small, soft, friable, and nearly worthless coke. The best of these coals compare favourably with the best English cannels, and approach the celebrated Australian shale, and are already shipped to foreign countries in competition with them. So favourable has been the results of comparative tests, that a large export trade in the future is confidently looked for. It is a matter for congratulation that the determined area of some of the most valuable deposits reaches over a wide extent of country—running into thousands of acres in some instances; thus ensuring a practically limitless supply. Inadequate railroad facilities have been the chief obstacle in the way of the more rapid development of Kentucky cannels. It is likely that the activity in railroad extension and industrial development through the South will render the markets of this country and of the world more readily accessible to the already developed coals, and lead eventually to the discovery of many valuable, but at present unknown, deposits.

The coal measures of Tennessee are an extension of those of Kentucky; and, entering from that State in a belt some 70 miles wide, continue the general south-west trend through the State—generally narrowing as they pass southward until they enter Alabama, cutting across the extreme north-western corner of Georgia. They occupy and are entirely confined to the Great Plateau of the Cumberland Mountains—a vast narrow table-land running entirely across the State north and south. There is no systematic geology of the State of recent determination; and as the Government make little or no provision for the compilation of statistics, or the filing of general information as to the progress of the development of her coal-fields, individual reports must be relied upon entirely. Therefore, it is difficult to make a complete or exact statement covering the whole area of her coal-fields.

We may divide the field into northern and southern divisions. In the southern, the coals are of a semi-bituminous character, are generally quite soft and friable, and are extensively mined for manufacture of coke; but towards the northern border of the State—in Scott, Campbell, and Anderson Counties—some very good gas coals and some excellent cannels are found. These coals lie in the upper coal measures, in which are found in this district 18 or more different seams of coal, all varying in thickness and in quality, and changing at times from bituminous coals to cannels or shales, as in the case of the Kentucky fields. Most of the seams are thin and irregular and worthless; but there is one seam, to which each successive explorer has given a different name, that is of comparatively uniform and persistent thickness, and which furnishes the best coal and the gas coal and cannel in the northern field. In the vicinity of Jellico Mountain, in Campbell County, there is found an excellent grade of cannel, which has been extensively shipped through the county for the purpose of enriching gas. The deposit is estimated to cover some 1200 acres, which ensures its permanency in the markets. The coal analyzes as follows:—

Volatile matter	49·85 per cent.
Carbon	35·03 „
Ash	15·12 „
Sulphur	0·74 „

The bituminous coal from the same district is a clean hard coal, with cubical cleavage, and bears transportation well. That it will serve well as a gas coal, the following analysis will demonstrate:—

Ash	1·60 per cent.
Carbon	60·60 „
Sulphur	1·16 „
Volatile matter	35·44 „

A very good gas coal—perhaps the best in this district—is mined in the southern part of Scott County. It is said to be similar to the best Pennsylvania coals in general physical characteristics, and to approach them in value in gasification. The coals found in the adjacent County Anderson are likewise of excellent quality. The following analyses are submitted to show their general character:—

	Coal Creek District.		Poplar Creek District.	
Carbon	57·52	..	60·67	56·12
Volatile matter	38·82	..	36·53	39·33
Ash	3·09	..	1·75	2·81
Sulphur	0·20	..	0·78	—

All the above figures indicate a first-class gas coal. These coals are supplied principally to the local Southern markets, and are not extensively shipped as gas coals beyond the limits of the State. The greater part of the production of these mines is sold for domestic or steam-raising purposes.

(To be continued.)

REGISTER OF PATENTS.

Charging and Drawing Retorts.—Ruscoe, J., of Hyde. No. 18,108; Nov. 13, 1889. [1s. 6d.]

This invention relates to apparatus for mechanically charging and drawing gas-retorts; and it is designed with the object (1) of simplifying the working parts; (2) of constructing the scoop so that the delivery of the coal from it, even in large lumps, will be performed so as to reduce to a minimum the shock to the body of the retort; and (3) of arranging the driving so that the several movements of the charging-scoop and of the drawing-rake may be easily performed, and be under the complete control of the attendant.

Fig. 1 is a side elevation of the charging apparatus; fig. 2, an end elevation; and fig. 3, a plan. Figs. 4, 5, and 6 are similar views of the drawing appliances.

The main frame A is built in the usual way—preferably in the form of a rectangular tower of angle, T, or channel iron bolted together. It is open in the centre, to allow for the upward and downward movements of the charging-scoop C, or drawing-rake D; and it is, as customary, supported on four wheels E running on rails F laid in front of the retorts in connection with which the apparatus has to work. In the charging apparatus, the principal improvements lie in the scoop, and in the arrangements for driving it forward into the retorts, and discharging and withdrawing it.

The scoop C is constructed in two separate parts placed one above the other, and capable of independent movement; the bottom part forming the bottom of the scoop and the top part the two sides. The top part consists of two longitudinal side pieces, deep enough to hold the required quantity of coal to charge the retort at one operation, connected together by cross-pieces, which also divide the scoop into divisions or chambers. To the rear end of the upper part of the scoop (farthest away from the retort) is attached a carriage G, which supports the scoop as it is projected into the retort. This carriage is constructed of two side pieces of flat or angle iron braced together, and carrying two or more pairs of rollers or runners. A scoop frame H is constructed of angle or channel iron—one at either side of the scoop C—extending the entire length of the frame in which the rollers run to and fro. The scoop-frame thus serves to support the scoop-carriage, and with it the upper part of the scoop, in any position as it moves to and fro into or out of the retort. Below the scoop-frame, and attached to it, or carried by it on stationary axes or studs, are a number of rollers or runners, which support the bottom part of the scoop, or on which it rests. The bottom of the scoop is constructed of channel iron in one piece or built up from plates; and the two sides of the bottom part stand up beside and embrace the side pieces, which are free to move inside and independently of it. When the scoop is at rest, and ready to be filled with coal, it is in the form of a channel; and the two parts of it are together projected forward into the retort to charge it. To empty the scoop and deposit the coal in the retort, the bottom part is first withdrawn; and, as it moves backwards, the contents of the several divisions are dropped into the retort (the several cross-pieces of the upper portion preventing the coal being carried back again, after which the upper part of the scoop is drawn back to its original position.

During the operation of charging the retort, motion is given direct to the bottom part of the scoop, and from it conveyed to the upper part, so that the movement of the latter is made to be dependent upon the lower part. As the lower part is caused to advance (by mechanism described later on), an upward projection I, of T section affixed to it, comes in contact with a similar downward projecting piece I^1 affixed to the scoop-carriage; and the two parts forming the scoop are carried forward together the full distance required to extend to the back of the retort. When this position has been reached, a small tumbler or pawl drops into a recess, or behind a projection formed on the side and front end of the scoop-frame H. Under the scoop and attached to the scoop-frame is a small frame J, upon bearings, in which rotate two

pairs of chain-pulleys, the bearings of which are stationary, while the bearings which carry the chain-pulleys are moveable to and fro in a slide J^1, formed in the frame J.

When the withdrawing movement is conveyed through the chain S to the bottom of the scoop, the top part is retained by the pawls or tumblers until the bottom has been withdrawn a given distance. The tumblers or pawls are then released by the chain T, and at the same time the projecting piece affixed to the bottom of the lower part comes in contact with a lug or horn on each sliding bearing of the chain-pulleys. By means of the chain T passing around the pulleys, as soon as the backward movement of the pulleys takes place the top part of the scoop is drawn back at a quicker speed than the bottom, and the two come to rest in their original position at the same time. The scoop-frame H is held suspended in the frame A, and is raised and lowered by the chains or ropes O O^1.

The main driving mechanism is placed on the top of the frame A; and it is actuated by a continually moving main driving-band K (preferably a cotton rope), which runs overhead across the entire apparatus in a line parallel to the face of the mouthpieces in the retort-house. This main band is driven at a quick speed; and it communicates motion to the pulley K^1, against which it is held by the two guide-pulleys. As the band passes over a drum or pulley at each end of the retort-house, it is always taut, irrespective of the position or any movement of the frame A or of any of the mechanism supported by it.

The first motion shaft, to which the rope pulley K^1 is attached, is preferably vertical, and transmits movement to the second motion shaft L by means of a bevel-wheel keyed thereon and two bevel-wheels placed facing each other and loose on the shaft L. The two bevel-wheels on the second motion shaft are always in gear with the bevel-wheel on the first shaft. Between the two wheels on the shaft L is a sliding friction clutch L^1, which engages with a clutch-box formed in the face of each of the bevel-wheels. Their clutch is provided with a key or feather on the shaft. Thus, if brought into contact with the one bevel-wheel, the shaft is rotated in one direction, and if brought into contact with the other wheel the shaft is rotated in the opposite direction; or, by being retained in a central position, the second shaft may be kept still while the first shaft is continually running.

The second shaft L has attached to it other mechanism, which serves to distribute the power for the following purposes: To raise and lower the scoop in the frame A; to propel the scoop into and withdraw it from the retorts; and to move the entire mechanism on the rails F from one part of the retort-house to another. For this purpose, on the shaft L are placed loose a worm M and bevel-wheel M^1, each provided with a clutch-box face; and moving on a key or feather in the same shaft is

Fig. 1.

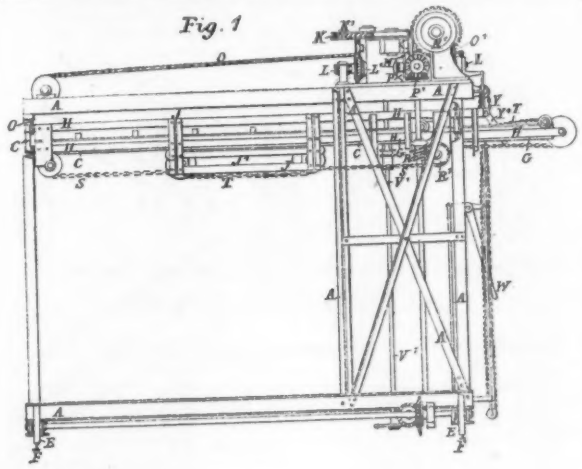


Fig. 4.

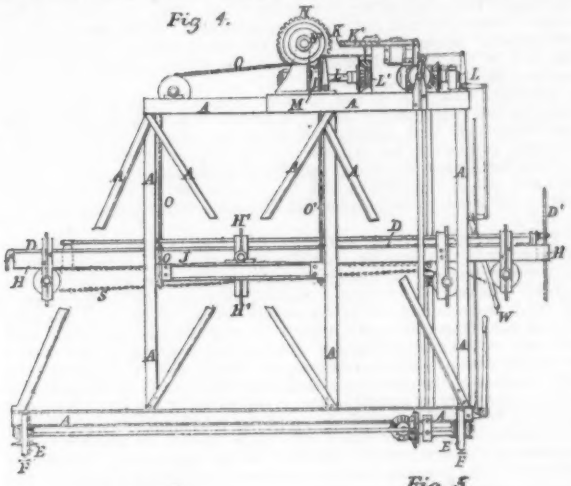


Fig. 2.

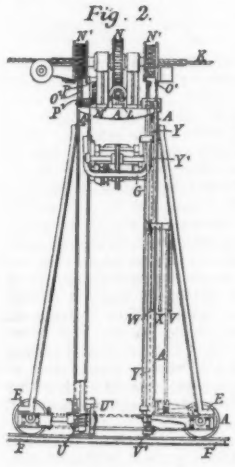


Fig. 3.

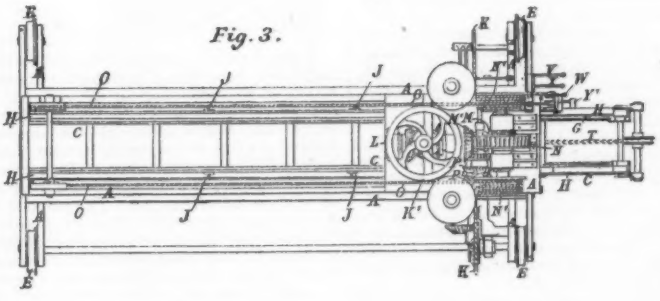


Fig. 5.

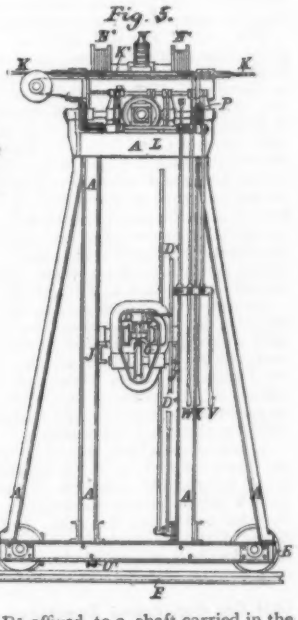
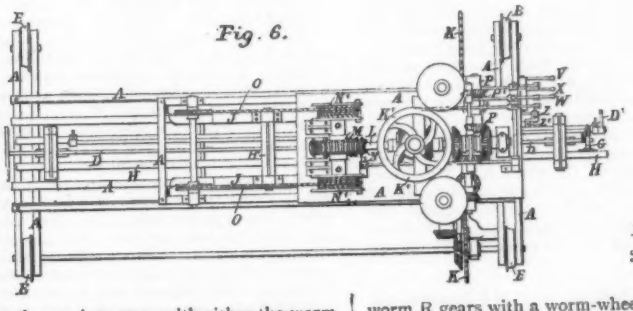


Fig. 6.



a friction clutch which can be thrown into gear with either the worm M or the bevel-wheel M^1.

For raising or lowering the scoop, a worm-wheel N is geared with the worm on the second shaft L. The worm-wheel is keyed to a cross-shaft, upon which are fixed two rope or chain barrels N^1, upon which wire ropes or chains are wound. Attached to each barrel are two such ropes O O^1; and the ropes O (one from each barrel) pass horizontally forward to the front of the machine over guide-pulleys, while the ropes O^1 (one from each barrel) descend vertically therefrom. The four ropes or chains are connected respectively to the four corners of the scoop-frame H by means of the adjusting screws.

For projecting the scoop forward into the retorts, and drawing it back again, motion is conveyed from the second shaft L by the bevel-wheel M^1 thereon to the cross-shaft through the double bevel-wheel P. This wheel also gears with another bevel-wheel P^1 affixed to the upper end of a vertical shaft. The function of this vertical shaft is twofold; but at present it will only be described with reference to the forward and backward movement of the scoop. The shaft is throughout its length slotted with a groove or key-way. Journalled or supported in a bracket of the scoop-frame H is a worm R with a key fixed therein through which the shaft passes, and to which it conveys its motion. The worm R gears with a worm-wheel R^1 affixed to a shaft carried in the brackets on the scoop-frame H (the scoop-shaft); and on it is placed a chain-wheel, which drives a chain S. Both ends of this chain are connected to a bracket affixed to the bottom part of the scoop, and then passing in opposite directions over the chain-wheel on the scoop-shaft, and over the carrier chain-pulley on the shaft supported in brackets at the front end of the scoop-frame H. A movement of the chain in either direction carries with it the bottom part of the scoop. A second chain T is attached to a counterbalanced or weighted lever T^1 on the spindle of the tumblers, and passes backward over a chain-carrier pulley, and thence under; he scoop-carriage and scoop-frame to the chain pulleys previously described; and after passing round each of these pulleys, the end is fixed to the frame J at a suitable point.

To move the machine from one place to another in the retort-house, the vertical shaft communicates (through a worm U affixed to it at its lower end) with, and gives motion to the shaft of one pair of the wheels E, which run on the rails F. The worm U gears into the worm-wheel U^1, which is connected with the shaft, on which is a bevel, by means of the clutch. The vertical shaft thus serves to move the scoop backwards and forwards, and also to move the apparatus from one retort to another. The two movements are applied by clutches in

connection with the worms R and U, and worm-wheels R^1 and U^1, which can be thrown into and out of gear. To prevent the two clutches being thrown into gear at the same time, they are connected together by levers and rods attached to the foot of a vertical rod V^1, to the top of which is attached the connecting lever.

The hand-levers V, W, and X serve to throw into and out of gear the several parts of the mechanism, which perform the different operations. The hand-lever W, through levers and connecting-rods, throws the clutch L^1 on the second motion-shaft L into contact with either of the bevel-wheels, whereby the motion in either direction is obtained for any part of the mechanism; and by this lever the direction of motion is reversed. The hand-lever X moves the clutch into contact with either the worm M or the bevel-wheel M^1 to lift or lower the scoop, or through the vertical shaft, to move the scoop into or out of the retort or the apparatus from one retort to another; and the handle V controls the clutches in connection therewith; and its movement determines which of these movements shall take place, but prevents both being carried out at the same time.

In order to make automatic the reversing movement of the scoop for withdrawing it from the retort, the chain Y is connected to a lever Y^1, which by a connecting-rod is coupled to a horizontal rod supported by one of the angles. This rod has a projecting finger, against which a moving projecting part of the scoop comes in contact when the scoop has passed the required length into the retort. The movement of the chain Y raises the rod, and reverses the clutch L^1 in the bevel-wheels, and another projection attached to the scoop comes in contact with the end of the rod, and, pushing it again, reverses the clutch L^1, or moves it into a central position.

Referring to figs. 4, 5, and 6, which relate to the apparatus for drawing the spent charge from the retorts, it may be remarked that the framework A is constructed in a very similar manner to the charger, supported on wheels E, running on rails F; and the driving mechanism for raising and lowering the rake D—for moving it into and out of the retorts, and for moving the apparatus along the rails—differs only slightly from that described with reference to figs. 1, 2, and 3.

The drawing-rake D is constructed of a steel or iron rod preferably rectangular in cross section, with a removeable head pivoted thereto so as to swivel towards the machine when passing over the coke into the retort. The rod of the rake is carried by a carriage G, the runners of which move to and fro in the channel-irons, which form the sides of the rake-frame H—very similar to that already described with reference to the charging-scoop. The rake is mounted so that it may swivel or oscillate either vertically or horizontally so as to suit the requirements of the operator. Below the rake-frame, and attached to it, is a subsidiary or second frame J, supported at the four corners by ropes O O^1 from the barrels N^1; and the rake-frame is connected to it by trunnions on either side of the cradle bracket H^1 which is firmly attached to the longitudinal members of the rake-frame. The blocks which form the journals for the trunnions slide along the frame J, and may be attached to it in any desired position.

The rod at the end where it connects with the rake-carriage is pivoted on an upright pivot, upon which it can oscillate horizontally, to allow the head of the rake to be moved from one side of the retort to the other. This oscillating movement is effected by a hand-lever D^1. The shaft is cut with a groove or key-way, in which a feather in the boss lever slides; the sliding movement being obtained from the rake-carriage G, as it moves along, by a stud projecting from it into the annular groove of the lever. By the double oscillating movement on the horizontal trunnion and on the upright pivot, the rake may be caused to swivel in any direction. The rake is moved backwards and forwards by the chain S, both ends of which are attached to the rake-carriage. It passes over the carrier chain pulleys, and is actuated by the chain-wheel on the rake-shaft. This latter shaft is actuated by the sliding-worm E on the vertical shaft from the bevel-wheels M^1 on the second motion shaft L, through the bevel-wheels P P^1.

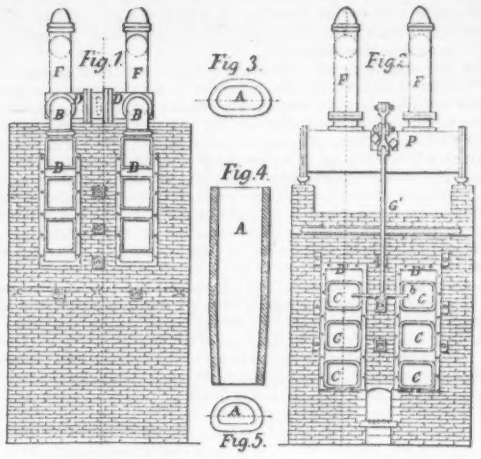
Instead of using one vertical shaft to perform the double function of drawing the rake in and out, and of moving the apparatus along the rails, a second vertical shaft is employed, which, at its upper end, connects with a bevel-wheel on the second motion shaft L by means of bevel-wheels. At its lower end it connects with the shaft of the wheels R, by means of the worm U and worm-wheel U_1. By this arrangement, the advantage is gained of having all the change motions placed at the top of the framing.

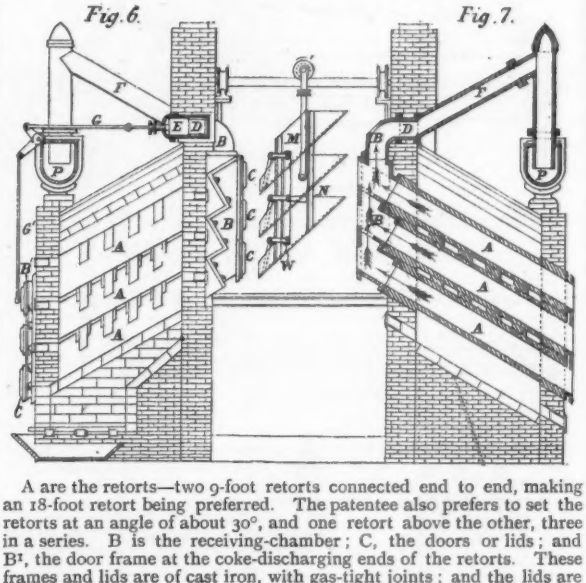
As has already been described with reference to the charging-scoop, the hand-lever W, with its connections, serves to operate the clutch L^1 to reverse the direction of motion of the shaft L. The hand-lever V serves to move the clutch which sets the worm M in motion to raise and lower the rake; and the handle X throws a clutch into either of the bevel-wheels provided for the purpose, in order to move the rake into or out of the retorts or to move the frame on the rails F.

Coal Gas Generating Apparatus.—Thomas, J. J., of Roxborough, U.S.A., Oct. 24, 1890. [8d.]

The claims for this invention "for generating illuminating and heating gas from coals," are: 1. The combination of two series of retorts, a mixing-chamber having an intermediate valve, and two saddle-pipes. 2. In apparatus for charging retorts making coal gas, a travelling car, consisting of a series of fixed inclined pockets, in combination with a gate, one for each pocket, and a connecting-bar, connecting and operating the gates. 3. A retort for making coal gas, constructed with a contracted discharge end. The first combination is arranged for so that the gas from one set of retorts may at will be mixed with the gas from the other set before it reaches the liquid seal in the hydraulic main; while the second provides means for charging two or more retorts at the same time.

Fig. 1 is a back elevation of a bench of six retorts, showing the receiving and connecting chambers. Fig. 2 is a front elevation of the bench, showing the hydraulic main, saddle-pipes, and connecting rod for operating the intermediate valve. Figs. 3 and 5 show end views of one of the retorts. Fig. 4 is a longitudinal section of one of the retorts, taken on the dotted lines of figs. 3 and 5. Fig. 6 is a vertical section of fig. 1. Fig. 7 is a vertical section of fig. 2.





A are the retorts—two 9-foot retorts connected end to end, making an 18-foot retort being preferred. The patentee also prefers to set the retorts at an angle of about 30°, and one retort above the other, three in a series. B is the receiving-chamber; C, the doors or lids; and B^1, the door frame at the coke-discharging ends of the retorts. These frames and lids are of cast iron, with gas-tight joints; and the lids are fastened in the usual manner. D is the connecting-chamber; E, the valve; and F, the saddle-pipe—all these parts being made of cast iron, or other metal if desired. The valve E is connected by rods G, G^1. At the lower end of the rod G^1 is a cross-bar or handle, which lies across the two upper lids of the discharging ends of the retorts, when the valve E is open. The discharge end of the retorts is of less width than the receiving end, as shown in fig. 4. The contraction commences about one-third the length of the retorts, from the discharge end. A 26-inch wide retort at the receiving end would be contracted to 20 inches at the discharge end. M is the charging-car, hung on the axle of an overhanging railway car, which runs between two rows of benches, and is hung by a swivel, so as to turn and charge either row of benches. The car is divided into three pockets—one for each retort in the series to be charged. Each pocket has a door or gate, connected to the handle N by the bar W.

The patentee, in his specification, here says: "It is well known to gas engineers that the first running of gas is always rich in illuminating quality, but of low temperature; the last runnings poor in illuminating quality, but of high temperature. If the rich gas reaches the liquid seal at a low temperature, it will not be a permanent gas, but will yield a larger percentage of tar than when the gas passes the liquid seal at a high temperature. For the above reason, I have invented what I term an intermediate mixing chamber placed between the two series of retorts, working the retorts with four-hour charges (one set of retorts being charged two hours previous to the other), and the communication between the two sets of retorts is controlled by a valve or gate placed in a connecting-chamber."

The operation of the apparatus is as follows: Each pocket of the charging-car M is supposed to have been supplied with the quantity of coal to charge each retort in the series; and the car is then run in so as to insert it into the mouths of each retort. The handle N is then pressed down; and this moves the bar W, which opens all three gates, and the coal will, by its own gravity, be discharged into the retorts. The retorts, being contracted at their lower ends, will cause the coals to be evenly distributed over the bottom of the retorts their full length. The lids C are then put on the mouths of the retorts, and fastened by the usual appliances. The gas from each series of three retorts at once passes up through the chamber B and saddle-pipe F to the hydraulic main P; and after one of the series of three retorts has run two hours, the lids C at the discharge ends are opened, and the coke discharged. When the lids at the charging ends of the retorts have been opened, and the charging-car containing a charge of coals for the three retorts inserted in the ends of the retorts, the gates opened as before described, and the coals run into the retorts, the lids C are placed on the charging ends of the retorts, and made fast; and the rod G^1 is then pulled down so as to

bring the bar across the lid C, as shown in fig. 6. This will open the valve E; and the hot gas rising from the retorts running more than two hours will pass the valve and mix with the gas from the retorts last charged. The rich gas will be heated by the poor hot gas; and the mixed gases will pass the seal a rich and more permanent gas than if they pass singly. When one of the sets has run four hours, the rod G^1 is pushed up, which closes the valve E, and the retorts that have run four hours are opened, the coke discharged, and refilled by coals from the charging-car (as described), the valve E opened, and the rich cold gas mixed with the poor hot gas as before.

APPLICATIONS FOR LETTERS PATENT.

20,872.—PEARSALL, H. D., "Improvements in meters." Dec. 22.

20,873.—PEARSALL, H. D., "Improvements in water pipes and mains." Dec. 22.

20,888.—HOLT, H. P., "Improvements in motor engines worked by gas, or by oil, or other vapour." Dec. 22.

20,892.—OAKMAN, R. N., jun., "Improvements in valves for water-gas plant." Dec. 22.

20,971.—GILMORE, J., and CLARK, W. R., "An improved liquid-meter." Dec. 23.

21,158.—ROBBINS, R., "Improvements in joints for water and other pipes." Dec. 29.

21,165.—LENTZ, H., CZERMAK, F., STREITMANN, and BERGL, A., "A single acting gas motor engine." Dec. 29.

21,217.—HEATON, C. W., "Improvements in the treatment of the Claus process of gases [*sic*] containing sulphuretted hydrogen, and recovery of valuable products therefrom." Dec. 30.

21,300.—THOMAS, T. C. J., "Improvements in regenerative gas-lamps." Dec. 31.

Electric Lighting of Holland House, Kensington.—The Wenham Company, Limited, have obtained the contract for the electric lighting of Holland House, Kensington, the residence of Lord H. Chester. It must be gratifying to the Company to find they have been entrusted with the installation of the new system of illumination in this historical mansion, following as it does the successful completion of similar work executed by them at Craig-y-Nos Castle, the residence of Madame Patti-Nicoline.

The Wages of Gas Stokers at Dewsbury.—After a conference with a deputation representing the stokers and labourers employed at the Dewsbury Corporation Gas-Works, the Gas Committee have resolved that the wages of the former for all Sunday employment shall be at the rate of time-and-a-half, and double time for Christmas Day, Good Friday, Whit-Sunday, and the August Bank holiday; no wages to be paid to those men who do not work. Other concessions have been granted, and accepted by the men.

Messrs. H. Darwin and Company, Limited, is the title of a Company registered in Scotland with a capital of £15,000 in £5 shares. Its objects are stated to be: "To acquire, by purchase, licence, or otherwise, patents, patent rights, licences, secret processes, trade-marks, and other privileges of a like nature, whether British or foreign; to sell the same, work them, or grant licences thereof; to adopt an agreement between Harry Darwin, gas cooking and heating apparatus manufacturer, of Glasgow, trading under the name of H. Darwin and Co., and John Best, contractor, of Edinburgh, on behalf of the Company; to carry on the business of engineers, especially for the purpose of heating, lighting, and cooking by means of gas, oil, or otherwise, and to manufacture."

Experiments on Fire-Damp Mixtures.—A Commission on colliery explosions, appointed by the French Board of Trade has (says the *Coal and Iron Trades Review*) published a report on a series of experiments made by Messrs. Mallard, Le Chatelier, and Chesneau, mining inspectors and engineers, upon the effects of sparks produced upon mixtures of air and fire-damp, by miners' picks striking hard rocks. For this purpose mixtures were used of pure formene and air, and of these mixed with ordinary illuminating gas. These were made by passing the gases through multiple Bunsen burners into a wooden box, placed against granite and porphyry blocks, so disposed that by striking them with a pick the sparks fell into the box. Mixtures of illuminating gas and air were easily exploded by the sparks, whenever they were large enough to remain incandescent during an appreciable time—a result obtained with nearly every blow. The sparks are formed of metallic particles burning strongly, and forming globules of magnetic oxide. With mixtures of formene and air, no inflammation could be obtained, although more than a hundred experiments were made under conditions in which a mixture of illuminating gas and air would certainly have been ignited. This difference is probably due to the inflammation of formene requiring a much longer time than that of illuminating gas, and the sparks becoming cold before it can be effected. Further experiments were made with mixtures of formene, illuminating gas, and air. When the mixture contained equal quantities of two gases, explosions were sometimes obtained; but with mixtures containing 75 per cent. of formene, and 25 per cent. of illuminating gas, no explosion took place. As the best analyses of natural fire-damp show it to be composed of pure formene with only 3 to 4 per cent. of other gases, the Commission concludes that the ignition of fire-damp in collieries cannot be produced by sparks from miners' picks. The picks used were both steel and more or less steely iron; but besides these, picks of steel (containing 13 per cent. manganese aluminum bronze with 8 per cent. aluminum and 2 per cent. silicon) were tested. The former give off hotter and larger sparks than iron picks, and ignite explosible mixtures still more easily; while on the other hand, the aluminum bronze picks, whose hardness nearly equals iron, do not produce sparks, and could not be made to ignite any of the mixtures. This is rather important, as although the ordinary fire-damp may consist chiefly of formene, there is no certainty that no other gases may be enclosed in the coal and set free at times; and if bronze picks are absolutely safe, they should by preference be used. By suitably mixing the alloy, or treating it in forging, no doubt sufficient hardness for coal-mining purposes could be produced.

LEGAL INTELLIGENCE.

THAMES POLICE COURT.—Wednesday, Dec. 31.

(*Before Mr.* MEAD.)

Shooting at a Gas-Works Foreman.

Henry Attwell, 34, a labourer, living at No. 9, Prestige Street, Poplar, was charged with attempting to murder Robert Burn, a carbonizing foreman in the employment of the Commercial Gas Company, by shooting at him with a revolver.

Mr. G. H. YOUNG, Solicitor, prosecuted.

Complainant said he was carbonizing foreman in the retort-house at the Commercial Gas Company's works in Leven Road, Bromley; and up to three weeks ago the prisoner was employed at the same place as valve-man. He was discharged; but witness did not know what for. On the previous night he was in Abbott's Road, and met the accused, who called out to him. Witness turned round, and saw Attwell with a revolver, which he pointed at him. Prisoner fired, and witness put his head on one side, and as he did so he heard a whizzing noise. Attwell was about 6 feet from him at the time. Witness rushed at him, knocked the revolver out of his hand, and seized hold of him. Two young men, who came to his assistance, told prisoner he might have killed witness; and he answered, "A good job too; and four or five more as well." Attwell was given into custody, and taken to the station. Witness picked up the revolver, and handed it to the policeman.

Police-constable *Gripley* stated that the accused was given in charge in the East India Road, for firing a revolver at the prosecutor. Witness took hold of the prisoner, who said, "They are not balls; but they are shot." When the charge was read over to him, he said, "If I had wanted to murder the cur, I should have put a ball in." Witness handed the revolver to the inspector.

Inspector *Eccles Golding* said he was on duty at the Poplar Station when the prisoner was brought in. After he was charged with attempting to murder prosecutor, he at first did not reply, but afterwards made the statement the constable had given in evidence. Witness examined the revolver, and found it had six chambers, three of which were loaded with cartridges containing powder and shot, and one contained a spent cartridge.

The prisoner was remanded.

Thursday, Jan. 1.

(*Before Mr.* DICKINSON.)

The Commercial Gas Company Fined for Deficiency in Illuminating Power.

To-day the Commercial Gas Company were summoned for supplying, at one of the testing-places in their district, gas which was below the prescribed illuminating power.

Mr. C. A. ROBERTS prosecuted on behalf of the London County Council; Mr. G. H. YOUNG appeared for the Company.

Mr. ROBERTS stated, in support of the action taken by the Council, that when the Company's gas was tested, the illuminating power was found to be 15·1 instead of 16 candles, which was the standard.

Mr. YOUNG said he would admit that the Company had incurred a forfeiture; but he thought the Magistrate would be satisfied that the deficiency in the illuminating power of the gas was not due to any negligence on their part. They always did all they could to supply the public with gas of the proper quality; but on this particular occasion, they were unfortunate enough to get below the standard. This was due to some inferior coal which was supplied to the Company on the 26th of August. At that time they were not able to get the coal from their usual mines, and had to contract with a new firm. As soon as the deficiency was discovered, a telegram was sent to the persons who supplied the coal, and strenuous efforts were made to bring the gas up to the proper illuminating power. After a few hours they were able to do this. Unfortunately, the usual Gas Examiner was away on the day when the deficiency was recorded; and his substitute, for his own convenience, took the test very early, before the Company had time to recover themselves. This accounted for the deficiency.

Mr. DICKINSON said he thought the excuse was, to some extent, a reasonable one; and, under the circumstances, he would order the Company to pay a fine of 20s.—half the amount of the specified forfeiture. As the County Council had been at some expense in the matter, he would allow them £4 4s. costs.

Gas Explosion at Margate.—Last Saturday morning a violent gas explosion occurred at No. 10, Athelstan Road, Margate, caused, it is believed, by the absence of water in a chandelier. The occupant's daughter was blown through a window and seriously hurt; and the whole of the contents of the house were more or less damaged.

Tideswell (Derbyshire) Gas-Works.—The Directors of the Tideswell Gas Company have been considering the advisability of removing their works to a site at a place known as Miller's Dale, adjoining the Midland Railway. If the proposal is carried out, the Railway Company will become large consumers of gas; and, moreover, the cost of carting coal from Miller's Dale to Tideswell (2s. 3d. per ton) will be saved. At a recent meeting of the Directors, they expressed themselves unanimously in favour of the project.

The Gas Question at Whitehaven.—A public meeting of ratepayers has been held at Whitehaven for the purpose of receiving the report of a deputation appointed to wait upon the Directors of the Gas Company respecting "the present excessive price of gas." The report showed that the interview took place on the 10th ult., and stated that no good reason was advanced on behalf of the Company to justify the existing charge. The Directors said it was owing to the high cost of coal that they could not lower the price; and they expressed regret that they were unable to accede to the wishes of the deputation. The report recommended the Town Trustees to consider the expediency of having the district lighted by means of electricity, and the public to consume as little gas as possible. The report was unanimously adopted.

MISCELLANEOUS NEWS.

THE MARKET FOR SULPHATE OF AMMONIA DURING THE PAST YEAR.

As on previous occasions, we have received from Messrs. Bradbury and Hirsch, of Mason's Buildings, Liverpool, a copy of their interesting "Annual Review of the Market for Sulphate of Ammonia," for notice in our columns. Although somewhat shorter than in former years, it consists, as before, of some general introductory remarks, and a review of the course of the market month by month; the usual tabulated statistics being given at the end.

Messrs. Bradbury and Hirsch commence by saying that their record of the history of the sulphate market during the past twelve months must of necessity be brief; for notwithstanding the wide margin between the opening and the closing prices of this commodity, the year 1890 was almost uneventful, excepting for perhaps a brief period before its close. They therefore confine themselves to simple facts, such as they will have appeared before the student of the course of the market.

Measuring, in the first instance, the values, a critical examination of them reveals that they were at a moderately high rate at the beginning of the year (£12 to £12 2s. 6d.). In this respect they contrast strangely with those at the end (£10 15s.); the figures, according to appearances, then showing the market to be in a low and desponding state. To explain the reasons for this depreciation is the by no means easy task the authors set before themselves; and before commencing it, they point out that the decline during November was contrary to the precedent of the previous three years.

The influence of nitrate made itself felt to some extent, through the low range of values throughout the whole of 1890; but prices varied so little until quite recently, that it would be fallacious to attempt to consider the rise or fall of sulphate solely upon this basis. For instance, in the month of January the relative positions of the two commodities were as follows: Sulphate was quoted at £12 3s. 9d. down to £11 17s. 6d. per ton; and nitrate at 8s. 4½d. to 8s. 3d. per cwt. By the end of June, sulphate had declined to £11 2s. 6d.; while nitrate, after having touched 8s., was again quoted at 8s. 3d.—*i.e.*, sulphate exhibiting a drop of about £1 per ton; nitrate remaining practically unaltered. It is unlikely, therefore, that from this point of view it can be attempted to demonstrate any regulating influence of the nitrate prices upon those of sulphate. Between June and October, nitrate touched 8s. 6d. per cwt.—say, 5s. per ton advance (the improvement having been brought about by the advices from Chili of strikes and riots at the works, as well as on the railway lines and at the shipping ports); and sulphate reached £11 15s. during the same period, or an increase in value of 12s. 6d. per ton. By the sophistry of a venturesome spirit, the cry might have been raised that the advance in sulphate was due to the better feeling and improvement in nitrate; but such a theory could not be supported, as almost the whole and sole cause of the change in the sulphate market lay in the demand for America, which had suddenly sprung up—a view which is fully corroborated by the facts that, during the whole of the period mentioned, the dealers had been "bearing" the market, and that the market was sluggish until the American demand arrived. America absorbed in all about 3000 tons—the bulk of it during the period of short production. This is mentioned to indicate that the market would in all probability not have advanced one shilling but for these special requirements.

Digressing for a moment, the authors devote a small portion of their "Review" to a consideration of the American demand, as that country's requirements are, they say, likely to influence our market for some time to come. With regard to the uses for ammonia in the United States, they allude to the comparatively new one of its employment for ice-making and in connection with the refrigerating business, to which reference has already been made in the JOURNAL. They remark that in this direction a large future is opening for the consumption of ammonia; our American neighbours having probably found out that it suits their purposes much better to produce a constant supply of ice than to rely upon the season, not to speak of the deterioration and loss from transit, storeage, &c. They point to the fact that there is a reported falling off in the production of ammonia, on account of the greater extent to which the consumption of water gas is now carried on in America; and ice makers have, therefore, to look for other sources of ammonia supplies.

Resuming their argument about nitrate *versus* sulphate, Messrs. Bradbury and Hirsch say it seems to be hardly worth reiterating, except for the purpose of once more drawing attention to it, that the vast difference in the producing powers of the two fertilizers, blocks the way towards bringing them into proper relationship; and whoever may attempt to draft a cast-iron rule for their relative values will find it a vain endeavour. It should be remembered that during the past twenty years, the shipments of nitrate have increased from about 100,000 tons to upwards of 1,000,000 tons; while in the same period the world's production of sulphate has not advanced more than by about 160,000 tons (it was something like 40,000 in 1870). While, therefore, the production of sulphate was about one-half that of nitrate in 1870, the progress since has been at the average rate of one (sulphate) to six (nitrate); the production of sulphate being to-day only double that of nitrate in 1870, while the production of the latter is to-day tenfold that of the same year. Do not these figures, they ask, make one stand aghast at the probable consequences to agriculture, chemical and other works, &c., if nitrate were not a serious, though in the above sense friendly competitor, or what the price of sulphate might be if the whole and sole onus of the ammonia supply were thrust upon the gas industry? It may be said that ammonia will always be available while our coal supply lasts; but does not the small progress made in the carbonizing processes demonstrate that this industry is not to be carried on very profitably unless the prices of ammonia reach a very high level? Clearly, we have not moved a single step farther owards establishing on anything like a tangible basis, the connecting-link as far as the values of the two commodities are concerned; and for the present the influence of nitrate upon sulphate must remain one of sentiment.

The authors next endeavour to seek a reason for the low prices of both sulphate and nitrate during the last two months of the past year. They dispose of nitrate with the simple statement that over-production is its bane, and that the world, however extremely rapid the increase of consumption may have been, can hardly absorb unlimited quantities; and although the actual position of this commodity is barely worse than it was twelve months ago, always assuming a further increase in the consumption next spring, it seems to be more the "dark future" which overshadows the market, if an arrangement to limit the production proportionately with the rate of consumption is not come to among the nitrate companies. Still speculation bears a share in the present depression, for there has been persistent "bearing" for months past; and, from a speculator's standpoint, it cannot be said that such a venture was unreasonable. Then they go on to inquire whether the existing low prices of sulphate may be attributed to speculation. They remark, on this matter, that the key-note to the decline in November was undoubtedly given from the London market. The large producers in that market then thought fit to reduce their quotations quite unexpectedly; and the reason for this step has as yet remained undefined. The circumstances of the lowering nitrate prices and of the panic in the financial world may, however, have been held partly responsible for it. But although the aspect of the nitrate market might have caused alarm to a faint-hearted or weak-kneed producer, it should have put wealthy companies on their mettle; for has it not been proved by years of experience, by the demand during the past twelve months, the state of the stocks, &c., that all the sulphate produced is still being, and will be, consumed? Besides, an unreasonable lowering of values, even during a momentary panic, means an unnecessary reduction in the exchequer of the gas-works throughout the kingdom; for it must be admitted that the heavy production of the Metropolis must sway, if not control, the country markets. The only people who benefit by a movement of this kind are the speculators. The financial crisis could hardly be made a plausible excuse for offering sulphate at a considerable abatement; for the cloud which affected the money market touched but lightly the produce exchanges, and was least of all considered distressing to the sulphate market. The lower prices did not bring forth an increased demand from consumers. On the contrary, they were frightened away by the fear of still lower rates; and the bulk of the sulphate disposed of at the cheap figures came into the hands of the dealers. It must be inferred, therefore, that sulphate as well as nitrate had been sold short, and that consequently speculation had to answer for the recent low figures. They would have been preventable had producers been better guided. Sulphate and nitrate have, therefore, had this much in common—that the present low level of prices was greatly the result of speculation; and that in both commodities about the lowest figures on record were touched.

There is still to be accounted for the decline of sulphate during the months of November and December last year, in contrast with the advance which took place during the previous three years at the same period. Messrs. Bradbury and Hirsch say the latter movement was explained by the change in the *modus operandi* in securing their supplies on the part of continental consumers—first, because as the autumn requirements became less, the spring necessities grew; and, secondly, because these buyers seemed to choose the months of heavier production as likely to be better suited during that period. The only argument to be found for the change in 1890 is that, in consequence of the strange position of nitrate and the uncertainty of the future, consumers of sulphate whose wants had not been filled by speculators refrained from coming in for their supplies; and they were encouraged in the belief that the lowest point had not been touched. The average difference in the corresponding values of sulphate and nitrate has been fully £3 per ton in favour of sulphate (ton for ton); and as sulphate at £11 and nitrate at £8 show their unit values of nitrogen at 11s. and 10s. respectively, sulphate is the gainer of £1 per ton, through its nitrogen being paid for at a higher rate. It may now be accepted as an incontrovertible fact that, for a multitude of purposes, no substitute for sulphate is available.

The introductory portion of the "Review" concludes with a few observations about the future; and, as Messrs. Bradbury and Hirsch regard this as being a specially important matter to both producer and consumer at the present time, we give their remarks in full: "Will the production overtake the consumption?" will be almost the first question asked. We have already partly answered it when discussing the main point at issue. The production is proceeding at too slow a pace, the sources being limited, to prognose such a disastrous event; and, as we have often endeavoured to explain, there are besides the constant increases of consumption in the various manufactures of ammonia—soda, hydrate, and carbonate ammonia, &c.—new outlets turning up year by year, be it for agricultural uses in far-away countries, where scientific manuring has been unknown, or for chemical purposes in the Old and the New World. Simultaneously, natural sources—such as from guanos, &c.—diminish all the while. A shrinkage of values beyond what we have already experienced is therefore unlikely, whatever the price of nitrate may be; for nitrate is not a substitute for sulphate beyond its direct application for fertilizing purposes. Nitrate is, however, scarcely likely to fall below present values, which are the lowest ever experienced; and prices being below the cost of production, or rather the cost of laying it down in Europe, this industry cannot be carried on indefinitely at a serious loss. The consumption in the coming season ought to be good for both sulphate and nitrate. Low prices usually stimulate consumption, if not before, at all events during the season; and the past year having been a fairly prosperous one for the farmers, the latter are in a good position to buy manures. As in many cases sulphate showed better results last year than nitrate, owing to the wet seasons experienced, it is on the cards that the requirements of sulphate may be larger than before; and America is almost sure to be an important factor in the spring requirements. In any case, it may be taken for granted that consumers, owing to their inactivity towards the close of 1890, are insufficiently provided; and we opine that the general necessities, condensed within a briefer period than usual, will produce enhanced values. Every-

thing considered, there seems to be little danger in respect of a further impact in values. We estimate the production in the United Kingdom during 1890, from all sources, at 140,000 tons—viz.:

	Tons.
Gas-works	106,500
Iron "	6,000
Shale "	24,500
Coke and carbonizing works	3,000
Total	140,000

We add the previous four years' production, adjusted from the detailed and carefully-compiled report of Mr. Alfred E. Fletcher, the Chief Inspector under the Alkali, &c., Works Regulation Act, 1881:

	1889. Tons	1888. Tons.	1887. Tons.	1886. Tons.
Gas-works	100,700	93,000	85,000	82,500
Iron "	6,150	5,300	5,000	4,000
Shale "	23,950	22,000	21,000	18,000
Coke and carbonizing works	2,800	2,500	2,700	2,000
Totals	133,600	122,800	113,700	106,500

The review of the market month by month is next given, as follows:—

JANUARY.—The market was disappointing to producers; and lower prices were quoted, in consequence principally of speculative movements. A report was spread of an entire cessation of demand. But this was merely a *ruse*, as dealers were very largely oversold; and the market was weakened simply for the purpose of covering short sales on satisfactory terms. A great number of parcels were put on the market to be tendered for at most inopportune times, and these greatly added to the depression. In view of all this, actual consumers withdrew from the market; leaving the field entirely to operators. The dull state of the nitrate market did not help to improve matters; and although plenty of transactions took place, the market nevertheless closed with a dull feeling—consumers evidently making common cause with the speculators in their attempts to bring the market to a lower level. The market fell from about £12 2s. 6d. at the beginning to £11 15s. at the close.

FEBRUARY.—The steadiness of the market during the greater part of February may be said to have been due to the policy employed by producers, who were most cautious sellers; and they frustrated the various attempts to force prices down further by avoiding to place on the market parcels except to meet the consumptive requirements. A better demand seemed to be springing up at the beginning of the month—the low quotations made at the end of January probably inducing some of the consumers to come in earlier; and £11 17s. 6d. was again obtainable. This price remained the value during the greater part of the month; and even £11 18s. 9d. was obtained for best makes. During the last few days of the month, makers were constrained to accept rather lower figures again, in consequence of the low quotations made by dealers; but only a small business was done at £11 15s. The position of nitrate became disheartening; and the consummation of a positive agreement among producers to restrict the output having been unsuccessful, values declined, and cargoes came down to 8s. per cwt. This was a serious matter, in so far as it reduced the nitrogenous value in nitrate of soda to 10s. 4d. per unit, against 11s. 10d. per unit in sulphate of ammonia; and this naturally had some direct influence on sulphate, although the wet season, conducing to a greater consumption of the latter and the declining stocks of sulphate, pointed to a maintenance of prices.

MARCH.—Although nitrate was dejected, sulphate notwithstanding improved in value; and with few exceptions, and for makes of poor test only, were prices below £11 17s. 6d. f.o.b. Hull accepted. The market would probably have advanced further had the orders not been mainly in the hands of speculators, who used every means within reach to place a check upon the market. As nitrate was selling at the same time at 8s. per cwt., a difference of £3 17s. 6d. per ton was established between the two commodities; and as stocks of sulphate were fairly cleared by the end of the month, it was evident that, notwithstanding the low price of nitrate, consumers could not be lured from buying sulphate. The market at the close was somewhat quieter, and £11 15s. was accepted for spot parcels.

APRIL.—The sulphate market unfortunately fell to a lower level than, in our opinion, we thought it would. The wretched state of the nitrate market was made responsible for the decline in this month. Nevertheless the full margin in the price between the two commodities was maintained; and this margin would probably have been greater, had it not been for the speculative movements which had been uppermost since January. The fact was that speculators, in view of the unfavourable position of nitrate, had been booking orders all along below ruling market prices; and had it not been for this business in "futures" at constantly lowering figures, producers would not have been "cornered," as it happened, at the height of the season. The season was besides an exceptionally poor one; no pressing or late orders of any magnitude having come in from consumers—a fact which worked favourably on the side of dealers. The low prices reached during this month seem to have been beneath the range anticipated by speculators, even if the good prices paid by them for summer and autumn delivery are taken into consideration. The position in itself was by no means a desperate one, as we were on the eve of the months of short production, and makers had it in their power to control the market better. As regards prices, they were fairly steady at the beginning of the month at £11 15s. f.o.b. Hull—gradually declining to £11 10s. towards the middle; and £11 5s. was quoted towards the close, with speculative offers even below this figure for May delivery.

MAY.—The market during May furnished evidence that the impressions created by the events during April were very near the mark; for, notwithstanding that the market was bare of orders at the beginning, the fluctuations did not then exceed 2s. 6d. per ton. The fact that there was not too much sulphate for disposal asserted itself especially when the dealers were obliged to supply their contracts. Prices consequeptly hardened; the improvement being about 5s. per ton. During the holidays a lull set in, and the closing value of the month was again £11 5s.; the actual range of prices having been between £11 2s. 6d. to £11 7s. 6d. We thus see that, although there was again a very large increase in the consumption of nitrate during the first four months of the year (about 150,000 tons), sulphate did not to any extent suffer thereby; and as nitrate was selling at £8 per ton, a margin of over £3 per ton between the two commodities was sustained. A good business was also done in forward contracts between June and September, and even into the spring of 1891, at a considerable advance on existing values; showing confidence in the future of sulphate on the part of buyers, notwithstanding the unfavourable state of the nitrate market.

JUNE.—The position during this month was generally steady, although the concerted action of dealers appeared at one time likely to induce a contrary tendency. Makers, however, seemed to recognize the fact that they could control the market equally with the dealers during the months of a small production; and, by their cautious sales, and aided by the demand springing up from the United States, they succeeded in keeping prices at about the previous level. As regards this demand for America, to which we alluded more fully in our general remarks, it had the effect that a large quantity of sulphate was drawn to Liverpool, owing to cheap freights from this port; and the smallness of shipments from Hull at the same time is accounted for by this. There was practically no change in prices, if simply the figures at the beginning and end of the month are taken (£11 5s.); but in the meantime business had been done at £11 2s. 6d. to £11 3s. 9d., and reports were spread that even £11 had been accepted in one or two instances. There was a decided inclination to pay enhanced values for future deliveries. But buyers' ideas did not quite come up to sellers' expectations; and, consequently, a large speculative business took place at from 5s. to 10s. advance above existing quotations.

JULY.—The firmness of the market was due to two causes—first and foremost, the firm attitude of makers keeping in check the movements of the speculators; and, secondly, the continued good demand from America—the latter reducing stocks to very narrow limits. Nevertheless, the advance gained during July was not obtained without a struggle, for the interest of dealers lay in an opposite direction; and the fruits of their tactics could easily be recognized in the lowering tendency of the Scotch markets in the face of the firm tone of other centres of supply. The firmness of the Hull, Liverpool, and London markets amply justified the indications we previously gave, that the near future of the market depended upon the action of producers; and the position of the latter was again strengthened by the American business, as well as by orders from Spain and several extraneous channels. What really surprised one was that the advance was not more marked; for, after all, it did not exceed 5s. per ton, although Beckton quotations might have shown a little more. Stocks were at a very low ebb; the quantity being apparently quite insufficient to meet any large demand which might turn up in August; and as many works were closed for longer or shorter periods for repairs, some scarcity during the coming month seemed imminent. The American requirements which it was thought had been completed were keeping fairly alive, too; and those who were seeking cheap parcels were evidently discomfited. There was, of course, no great benefit to be derived from the advance at that season of the year when the production is so small; but it enabled some of the producers to contract forward at fairly advantageous prices. As regards the actual figures, they ruled at £11 7s. 6d. at the beginning of the month; advanced to about £11 10s. during the second half; and closed at about £11 8s. 9d.

AUGUST.—The market during August continually improved, though by slow stages. The reason why values did not advance more considerably under the pressure of the demand may be briefly summed up in the constantly-increasing competition among shippers to secure orders—quotations being cut down to the flimsiest margin; and makers have to suffer in their turn through buyers being unable to accord any advance worth mentioning. The American requirements alone should have been sufficient to lift prices to a higher level; and there were simultaneously by no means insignificant outlets to Spain and the Colonies, as well as requirements on the part of other continental buyers. It therefore seemed almost an enigma that we did not reach at least £12—*i.e.*, the figure prevailing at the same time in the previous year. As we explained then, Scotland was to a great extent responsible—at one time, at least—for the low country values; and makers there seemed quite unable to exert any control over the market. It was noticed that there was now very little inclination for speculation of the "bear" kind; indicating that the future was viewed with some favour. Although approaching the eve of the larger production, contracts for delivery during winter and spring on the basis of the ruling values were sought after; and the position warranted such a view, as the autumn season would be commenced without any encumberance of stocks, while there was evidence that continental consumers were as yet little supplied, and a fair amount of engagements had been entered into by makers. Quotations, which stood at the beginning of the month at £11 10s., advanced to about £11 12s. 6d. about the middle, and closed at £11 15s.

SEPTEMBER.—There was a slow market during the whole of the month. But this condition may be said to have been, to some extent, artificial, for, when looking beneath the surface, it was found that all lots, whether offered from first or second hands, eventually found buyers; and therefore stocks did not increase sufficiently to cause alarm, or even apprehension. The partial cessation of the American orders afforded an opportunity to dealers to make their purchases on more favourable terms. Again, Scotch producers were the most anxious sellers; and down to £11 7s. 6d. f.o.b. Leith was accepted—this fact naturally affecting the English market to some extent. But the firm attitude of the English producers in a measure frustrated the designs of the operators. The nitrate market became somewhat stronger, without, however, affecting sulphate in the slightest; the latter being quoted at about £11 13s. 9d. at the beginning, and £11 10s. at the close of the month.

OCTOBER.—There was hardly any change in the market; the supplies and the requirements having apparently been evenly balanced. Early in the month a fair amount of spot orders from France helped to maintain the equilibrium; and later, when the French demand seemed satisfied, Belgium and Germany absorbed the available quantity. Besides this, there was a considerable amount of buying on the part of

dealers; but none of it was sufficiently eager to allow producers to take advantage of the market to raise their prices. The fact became again patent that consumers, almost by common consent, seem to bide their own time in their buying operations. They cease purchasing on the slightest symptom of a rise, and do not come in again until prices have reached their former or lower level. If we consider the unfavourable condition of nitrate at the time, a feeling of satisfaction remains that matters, as far as prices were concerned, were not worse; for nitrate declined about 10s. per ton, and the shipments were very heavy. There was little or no desire to buy for future delivery; it being generally anticipated that prices would be easier in November. The price ruled at £11 10s. during the greater part of the month; £11 8s. 9d. being quoted at the close.

NOVEMBER.—Both sulphate and nitrate touched in this month about the lowest price on record. We have already explained, in our general remarks, the causes of this great depression; and our deductions here will therefore be brief. The suddenness of the low prices was an unfortunate factor, in so far as they drove consumers, just about to come in to fill their supplies for the spring requirements, farther afield; instilling into their minds ideas which simply put business out of all question. Prices early in the month were still quoted at about £11 8s. 9d.; but within a few days they declined to about £11 2s. 6d.; country producers becoming scared at the rapid reduction in London values. Consequently by the third week the quotations had declined to £10 17s. 6d.; the market closing steadily at £10 15s. Nitrate, too, had fallen considerably—viz., to 7s. 6d. per cwt. It was reported that £10 15s. had been accepted by Scotch producers for December-March delivery.

DECEMBER.—Excepting a short spurt during the early part of the month, the market generally preserved a quiet attitude. The business was limited; the dealers being the principal buyers. Some American business was reported, but at low figures; and thus the prices between the beginning and the end of the month show hardly any fluctuations—£10 13s. 9d. being about the nearest value. Towards the close, the holidays seemed greatly to interfere with business; and continental shipments were hampered through frost—most of the near ports being ice-bound. Home consumers showed little inclination to anticipate their requirements; while buyers at the foreign ports evidently preferred to wait the turn of the year before operating. The strikes on Scotch railways caused some of the orders to be executed from the Hull market; but this business was not of sufficient magnitude to cause an improvement in prices.

From the tables which are given at the end of the "Review," we take the following:—

Production, Deliveries, and Exports of Sulphate of Ammonia during the Past Three Years.

	1888. Tons.	1889. Tons.	1890. Tons.
Production—			
England, Scotland, and Ireland, from all sources	122,800	132,700	140,000
Deliveries and Exports—			
Germany, Denmark, Sweden, Russia, &c.	32,000	32,000	31,000
France, Spain, and Italy	19,000	18,000	17,000
Belgium and Holland	18,000	20,000	23,000
America and Colonies	14,000	17,000	19,000
Home consumption, for agricultural and chemical purposes	31,300	40,000	44,000
Stocks	8,500	5,000	6,000
	122,800	132,000	140,000

Comparative Weekly Prices of Sulphate of Ammonia and Nitrate of Soda during the Year 1890.

Week ending	Sulphate of Ammonia. Per Cwt.	Nitrate of Soda. Per Cwt.	Week ending	Sulphate of Ammonia. Per Cwt.	Nitrate of Soda. Per Cwt.	Week ending	Sulphate of Ammonia. Per Cwt.	Nitrate of Soda. Per Cwt.	Week ending	Sulphate of Ammonia. Per Cwt.	Nitrate Soda. Per Cwt.
	s. d.	s. d.		s. d.	s. d.		s. d.	s. d.		s. d.	s. d.
Jan. 4	12 2	8 4½	April 5	11 6	8 0	July 5	11 4½	8 4½	Oct. 4	11 6	8 6
,, 11	12 1½	8 4½	,, 12	11 5	8 0	,, 12	11 4½	8 3	,, 11	11 7	8 6
,, 18	12 0	8 3	,, 19	11 3	8 3	,, 19	11 6	8 3	,, 18	11 6	8 4½
,, 25	11 10½	8 3	,, 26	11 3	8 3	,, 26	11 5	8 3	,, 25	11 6	8 3
Feb. 1	11 9	8 3	May 3	11 3	8 1½	Aug. 2	11 6	8 3	Nov. 1	11 5	8 0
,, 8	11 10	8 6	,, 10	11 3	8 0	,, 9	11 6	8 4½	,, 8	11 1½	8 0
,, 15	11 10½	8 4½	,, 17	11 4½	8 0	,, 16	11 7½	8 4½	,, 15	11 1½	7 9
,, 22	11 11	8 4½	,, 24	11 3	8 0	,, 23	11 8	8 4½	,, 22	10 10½	7 9
March 1	11 9	8 1½	,, 31	11 2	8 0	,, 30	11 9	8 6	,, 29	10 9	8 0
,, 8	11 10½	8 1½	June 7	11 3	8 0	Sept. 6	11 8	8 6	Dec. 6	10 8	7 9
,, 15	11 10	8 1½	,, 14	11 1½	8 0	,, 13	11 7	8 6	,, 13	10 10	7 9
,, 22	11 10	8 0	,, 21	11 2	8 1½	,, 20	11 6	8 7½	,, 20	10 8	7 6
,, 29	11 9	8 1½	,, 28	11 3	8 3	,, 27	11 6	8 6	,, 27	10 7½	7 6

Average Prices per Ton of Good Grey (24 per cent.) Sulphate of Ammonia, f.o.b. Hull.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.	Average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1881	19 17 0	20 5 0	20 0 0	19 15 0	19 11 3	20 5 0	20 6 3	20 10 0	20 7 6	20 10 0	20 11 3	20 15 0	20 4 6
1882	20 17 6	21 2 6	21 6 3	20 10 0	20 4 3	20 10 6	20 15 0	20 11 3	20 9 6	20 1 3	19 6 9	19 7 6	20 8 6
1883	18 15 0	18 3 9	18 8 0	17 3 9	16 18 3	17 5 6	16 5 0	16 7 0	16 10 0	15 5 8	13 17 0	13 13 0	16 11 0
1884	14 0 6	14 5 0	14 11 6	14 10 6	14 7 6	14 13 9	14 19 0	15 8 6	15 6 3	14 12 6	13 12 0	13 3 1½	14 9 3
1885	12 12 9	12 1 3	11 18 3	11 15 4	11 3 6	11 18 3	11 14 3	11 16 6	11 2 6	10 12 6	10 8 9	10 5 9	11 9 1½
1886	10 14 6	11 5 7½	12 11 11	12 5 0	10 17 0	11 0 7½	11 3 6	11 5 7½	10 18 5	10 13 9	10 11 11	10 15 7½	11 3 7½
1887	11 12 0	11 14 6	12 3 9	11 5 3	11 13 3	12 3 9	12 12 6	12 12 0	11 17 0	11 9 0	11 9 9	11 19 6	11 17 8
1888	12 15 8	12 5 8	12 0 0	11 18 2	11 7 6	11 13 0	11 12 10	11 9 8	11 7 9	11 14 8	12 6 7	12 5 0	11 18 0½
1889	12 10 7½	12 4 8	11 19 0	11 18 9	11 19 1	11 19 6	11 16 7	12 0 9	12 2 10	11 18 2	12 1 0	12 5 4	12 1 4½
1890	12 0 11	11 16 10½	11 16 0	11 7 2	11 5 3	11 4 1	11 8 5	11 12 3	11 11 3	11 10 4	11 1 3	10 14 1	11 9 0

Average Prices, 1868–1890.

1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880
£14 10s. ..	£15 15s. ..	£16 ..	£19 ..	£21 ..	£18 3s. 9d. ..	£17 2s. 6d. ..	£18 10s. ..	£18 12s. 6d. ..	£19 16s. 3d. ..	£20 5s. ..	£18 8s. 9d. ..	£19.

THE STRIKE AT THE BRIERLEY HILL GAS-WORKS.

The strike of gas workers at Brierley Hill (which has been referred to on two or three occasions recently) has led to police court proceedings on charges of assault and intimidation. The dispute, it will be remembered, arose in this way: Some time ago the Directors of the Gas Company received a printed circular from the Gas Workers' Union, asking for an alteration in the terms on which the men were employed. The Directors refused to treat with the Union; but expressed their willingness to deal with the men direct. This was not agreed to, and another letter was sent. The Directors still declined to negotiate with the Union, but instructed their Manager to deal with the men's demands in a reasonable way. The men would not concur in this, and gave a week's notice to leave. At the end of the time, the stokers, lamplighters, and labourers left the works; and soon after the Directors employed other men. One of the strikers, George Jones, became tired of idleness, and went back to work. A party of the men who went out afterwards waited at his lodgings, and tried to induce him not to go to work. There was a row, and the charges which came before the Brierley Hill Police Court last Thursday arose out of the disturbance. The first case heard was one in which John Young was charged with assaulting Miss Bates, the aunt of Jones, with whom he resided. In her evidence, she stated that Young and others called to see her nephew, and called him a "black sheep." She saw there was going to be a row, and ordered Young to leave. As defendant did not leave when requested a second time, she tried to eject him. He then struck her in the face three times, giving her a black eye. On the other side, it was asserted that the prosecutrix was drunk; that the defendant only called at her house for some ginger-beer; and that she, believing that her nephew was an object of hatred to Young, ejected him at once, and so commenced the assault, if there was one. The Stipendiary (Mr. Neville) reserved his decision until he heard the other cases. In these Joseph Homer, a labourer, and John Young, the defendant in the last case, were charged with assaulting George Jones, and with intimidating him. Prosecutor stated in evidence that he had worked for the Gas Company for eighteen years. He had been a member of the Union for a long time, and came out on strike. Later on he called at the club-house and said, in the presence of Young and Homer, that he should return to work. A man named Hinsley, hearing of this, said he should smash anyone's head who went to work. On Dec. 20 prosecutor, on leaving the works, saw at the gates two of the strikers. A police-officer went home with him; and a little later Young called at his aunt's house. He described the scene between his aunt and Young, and added that the two defendants now charged returned in half-an-hour; and Homer said, if it were not for the law, he would knock his (Jones's) head off, and Young added that, but for the law, murder would be done that night. Homer then shook witness, saying, "I will knock the life out of you." Witness added that the conduct of the strikers terrified him, and he was afraid. Corroborative evidence was given as to the assault and the threats. The Stipendiary said he thought the language used outside the house about "black sheep" hardly amounted to intimidation. As to the assault upon Miss Bates, he had no doubt; and it was a most cowardly thing for Young to do. As to Homer striking Jones and uttering the threats, the latter only showed that he thought the law was too strong for him and them. There was nothing against either defendant before; and so a fine of 40s. and costs would be inflicted on each defendant. The intimidation summonses were dismissed. Thomas Dunn and William Tonks, gas stokers, were also respectively charged with assaulting and intimidating John Hardwick, a lamplighter. The former was fined 10s. and 14s. costs, or fourteen days' imprisonment; and the charge of intimidation against the latter was dismissed.

The Cape Town and District Gaslight and Coke Company, Limited, have received cable advices of the transfer of the Cape Town Gas-Works and the purchase of the stock on terms very advantageous to the new Company.

GENERAL GAS LIGHTING AND HEATING COMPANY OF BRUSSELS.

From the report of the Directors of this Company which was presented to the shareholders at their annual general meeting on the 18th ult., we learn that the net profit realized by the undertaking in the year ending Aug. 31 last was 2,298,014 frs.; being an increase of 159,634 frs. on the figures for the preceding twelve months. Deducting the sinking fund and other charges, there was left a disposable balance amounting to 890,970 frs. After paying the statutory dividend of 25 frs. per share, and making certain allowances to the Directors and chief officers, a final dividend of 11 frs. per share was recommended—making 36 frs. per share, or 7·2 per cent., and leaving 16,050 frs. to be carried forward. The Company have a share capital of 11,677,500 frs.; and a sum of 10,552,000 frs. has been raised on bonds. The reserve and sinking funds make together a total of 8,203,234 frs. The Company possess 19 works, besides having a beneficial interest in two other gas undertakings—one being at Lisbon. The quantity of gas made in the period covered by the report was 24,415,562 cubic metres, of which 21,412,484 cubic metres were sold. The sales in the year 1888-9 were 21,018,020 cubic metres; so that there was an increase of about 2 per cent. The net profits show an improvement to the extent of 7·5 per cent. Of the 81,940,019 kilos. of coal carbonized, 59,028,404 kilos., or 72·04 per cent. remained as coke; the other products being 4,257,710 kilos. of tar, and 84,967 hectolitres (1,869,275 gallons) of ammoniacal liquor. The report was unanimously adopted.

THE SALFORD CORPORATION GAS COMMITTEE AND THE OUT-TOWNSHIPS.

The Opposition to the Corporation Bill.

A Meeting of ratepayers and owners in the Barton and Eccles district was held yesterday week, for the purpose of considering a resolution consenting to the opposition by the Local Board to the Bill promoted by the Salford Corporation for the purpose of enlarging their borrowing powers in respect of their gas undertaking—a matter to which reference was made in the JOURNAL last week. The Chairman of the Board (Mr. R. Spary) presided. In opening the proceedings, he said that the gas question had occupied the attention of the Board for a long period. Many years ago, long before Hunter was ever heard of, he (the Chairman) formed one of a deputation to the Salford Corporation asking for a reduction of the differential rate in the price of gas, which was then 6d. per 1000 cubic feet. They were successful in obtaining a reduction of 2d.; and the differential rate had since remained at 4d. above the amount charged in Salford. Within that period there had been a reduction of the price all round; but still the differential rate remained. There might have been a reason originally for the establishment of a differential rate. Salford in former days was practically far from Eccles; but recently Salford had come up to their own borders, so that the question of distance in relation to Eccles had become one of inches only. Salford had obtained a large profit out of the Local Board district for many years, and had used the district by virtue of their powers to supply districts beyond. In 1889, the Local Board took the opinion of Counsel; and that opinion was that the Gas Committee had no legal right to impose a differential rate. In asking for its abolition, therefore, they were asking merely for a right which they could enforce by means of the law. As a result of the negotiations with the Corporation, the matter was last March shelved for twelve months; for the Board did not care to become involved in a lawsuit. Now, however, that the Corporation were applying for an extension of their borrowing powers in respect of the gas undertaking, it was felt that the representatives of Eccles should make a stand; and if they could not obtain what they were entitled to, should go to the powers above the Corporation. He (the Chairman) was hoping that it might still not be necessary to go so far. The probability, he thought, was that the matter would be settled by an inquiry. If the Eccles people were forced to go to Parliament, they would have to open up a budget which the Corporation would not care to have unfolded. They would be compelled, against their desire, to bring forward the deficiencies and wrongdoing of the Corporation and their servants, and to show the blindness of Corporation Committees, to say the least, and the injury that these things had done to the gas consumers of their own and other districts. He proposed a formal resolution authorizing the Board to oppose the Provisional Order or Bill, and to pay for the opposition out of the general district rate. Mr. Alfred Burton, a member of the Local Board, said that, as nearly as could be ascertained, Eccles consumed gas for which a yearly sum of about £11,570 was paid to the Salford Corporation. Owing to the differential rate this was £1280 more than would be paid for the same quantity of gas in Salford; and the last-named sum was equal to a rate of 3d. in the pound upon the district assessment. After some further remarks, the resolution was carried.

ROCHDALE CORPORATION GAS AND WATER SUPPLY.

The Past Year's Working.

According to custom, the *Rochdale Observer* has published a retrospect of the past year; and in the course of it mention is made of the affairs of the Corporation Gas and Water Departments. Writing at the end of 1889 about the gas-works, our contemporary said the consumption of gas had so increased that, if the department were to be able to meet the demands made upon it, there must be an early extension of the plant. This anticipation, it now states, was soon justified; for in June the Town Council sanctioned important enlargements, estimated to cost about £3500. The work is now completed. Five beds of retorts, seven in each bed, have been added; increasing the productive capacity of the works by about 350,000 cubic feet per day. The Committee went to considerable trouble in discovering the best plant; and the result was that, after a visit to France, it was decided that the retorts should be set on the inclined system, instead of horizontally, and that stoking machinery should be adopted. An oxygen plant has also been constructed for use in the purification of gas. Both the new retorts and the oxygen plant have been brought into operation within the past few days; and the works are now equal to any demands likely to be made upon them during the next few years. Despite another large increase in consumption, the profit on the year's working of the department is (says the *Observer*) certain to be considerably smaller than that reported last March. There has been an unavoidable increase in expenditure. Owing to the advance in prices, an additional £5000 has had to be spent on coal; and the extra wages granted to the workmen at the close of 1889 means at least £1500. The only set-off to these considerable items is the increased receipts for gas, which will not be much more than £1000. The year has been only an average one for the residuals. Tar products have been in pretty fair demand. Sulphate has not fetched such good prices as formerly; but most of the other products are selling very well. The total output of gas from Jan. 1 until the morning of the 26th ult. was 240,159,000 cubic feet, or an increase on the same period of 1889 amounting to 9,597,000 feet. The increase in 1889 over the previous twelve months was nearly 11,000,000 feet. The heaviest day's consumption dnring the year was on Thursday, the 18th ult., when 2,319,000 feet were sent out. This is slightly larger than the highest record in 1889. In regard to the water-works, very satisfactory results have attended the year's working. For the year ended March, 1886, the deficiency was £16,653. By extension of supplies, diminution of expenditure, and cheaper rates for borrowing money, this was reduced to £10,000 for the year ending in March last; and the decrease still continues. Last year water rentals alone increased by £1374; and the expenditure was £1059 less than in the previous twelve months. For the nine months that have elapsed of the present Corporation year, the extension of trade has been quite equal to that of the previous year; the new supplies being chiefly in connection with dwelling-houses. There is thus every reason to hope that the deficiency on the department at the end of the current year will again show a considerable increase.

Cirencester Gas and Water Orders.—The Cirencester Local Board had under consideration last Thursday the Provisional Orders, which have been applied for by the local Gas and Water Companies. It was decided to assent to both Orders, with the exception of the clause in that of the Gas Company referring to the standard price of gas. The Company propose to fix it at 4s. 9d. per 1000 cubic feet; but this the Board consider is too high.

Fraudulently Using Gas at Oldham.—At the Oldham Police Court last Wednesday, James Clarke was summoned for disconnecting a meter from a gas-pipe, and also for fraudulently using Corporation gas. The Assistant Town Clerk (Mr. Bailey) stated that the facts were the same in both cases; but, under the Act of Parliament, it was necessary that there should be two summonses. Alfred Chadwick, a gas-meter inspector, deposed that he went to take the register of the meter at the defendant's shop on Dec. 15, when he saw that the inlet-pipe was loose, and that the outlet-union was disconnected. Only a portion of the gas used would pass through the meter in the condition in which he found it. Henry Chadwick, another meter inspector, said he took the state of the meter in question on Nov. 27, when it was all right. After hearing further evidence, the Magistrates imposed a fine of 20s. and costs for the first offence, and £2 10s. and costs for the second.

Northern Coal Trade.—The holidays have interfered with the output of coal; but the consumption has been somewhat larger than usual, and the stocks are limited, and prices are firmer. Best Northumbrian steam coal varies from 11s. 9d. to 12s., free on board; the railway strike in Scotland having caused some steamers generally trading to Scotland to come to this district for coal. Small steam coal varies from 4s. 9d. to 5s. per ton. For gas coal the demand has been very large, both locally and for shipment; and a number of sales at 11s. per ton have been made. During the last few days, the consumption of gas has been enormous; the Newcastle and Gateshead Gas Company having carbonized as much coal in recent days as is equal to 1000 tons daily, or not much short of three times the average quantity. Other local companies have also very largely increased their general consumption, and stocks have been brought down; but decreased use must now be expected almost daily. Gas coke is steady in sale; but the output has been large of late, and some works have accumulated fair stocks in the last week or two.

Extraordinary Consumption of Gas in Birmingham.—Under this heading a paragraph appeared in the JOURNAL last week with respect to the heavy consumption of gas in Birmingham, during the week ending Dec. 13. During the seven days ending Dec. 18, the output was further increased, and would have been much higher still during the week ended Thursday, Dec. 25, had not Christmas Day been equivalent to a Sunday. The following is the daily output of gas for the week ending Dec. 18: Friday, 21,403,000 cubic feet; Saturday, 18,799,000 feet; Sunday, 11,384,000 feet; Monday, 22,963,000 feet; Tuesday, 21,989,000 feet; Wednesday, 22,153,000 feet; and Thursday, 22,334,000 feet—making a total of 141,025,000 feet. The following is the daily output for the week ending Thursday, Dec. 25: Friday, 22,368,000 cubic feet; Saturday, 20,042,000 feet; Sunday, 11,838,000 feet; Monday, 22,757,000 feet; Tuesday, 23,001,000 feet; Wednesday, 24,076,000 feet; and Thursday, 12,189,000 feet—making a total of 136,271,000 feet. The highest previous weekly output was during the week ended Dec. 11, when it amounted to 136,710,000 cubic feet. In the week ended Dec. 19, 1889, the amount was 127,412,000 cubic feet; and that was the highest prior to Dec. 11 last. The highest daily output before Christmas Eve was on Dec. 9 last, when the consumption was 23,612,000 cubic feet. The continuous heavy demand which culminated in the extraordinary consumption on Christmas Eve has (says the *Birmingham Post*) taxed the manufacturing resources of the department nearly to the uttermost; and considerable additions to the plant will have to be made before another winter.

NOTES FROM SCOTLAND.

From our Edinburgh Correspondent.

EDINBURGH, *Saturday*.

The railway strike has been going down all the week, but is not yet over. A week ago it was estimated that 9000 men were on strike; to-day the estimate is 4000. Although the leaders of the men have all along protested that they never will yield, it is evident to all except partisans that they are fighting a losing battle. They have failed to arouse the public. Nearly everybody sympathizes with railway men in their long hours; but scarcely anyone so much as lifts his little finger to help them. Unless they can obtain outside assistance, their cause is lost. Meanwhile the railway companies have been able to carry on a restricted passenger traffic, and to move a little the vast piles of goods which have accumulated. Several trains of coal have been got into both the Edinburgh and the Leith gas-works during the week. More will come in to-morrow; and so far as they are concerned, no apprehension need be entertained of any inconvenience arising from want of coal. In Dundee, the coal supply in the gas-works threatened to run short; but the local coal merchants very handsomely undertook to furnish coal at reasonable rates. One of these, ex-Bailie Taylor, is reported to have sold a large quantity of the Marquis of Londonderry's gas coal to the Commissioners. Coal is being carried to Dundee by sea, which will be sufficient to prevent the supply from running short. The gas-works at Berwick were relieved last night by the arrival of a train of coal, which was getting scarce in the works. In Fifeshire several gas-works have this week been served with coal direct from the pits; the carriage being undertaken by the coal-owners, who employed their own pug engines for the purpose. Such expedients, it is expected, will not be required next week.

The Edinburgh and Leith Gas Commissioners sat for an hour on Monday—a most unusual thing for them—and indulged in discussions which give me hope that they may yet see their way to transact business in a more rational method. I have frequently complained that they hurry through their business without explaining it further than is done by the very bald statements in the minutes. Now some of the Commissioners are beginning to feel that the minutes do not contain sufficient information to enable them to understand what is going on. Mr. Kinloch Anderson raised the subject with the protest that it was too bad that members of the Commission should not be able to get the information they wanted, without tabling a substantive motion. Mr. Macnaughton said the work of the Commissioners was conducted with too much secrecy. He complained of the want of information as to the position of the Commission with reference to the railway strike; and said the Commissioners had to go to the newspapers for particulars on the subject. Bailie Archibald thought there should be discretion on all hands, when they were in the midst of a strike, the leading principle of which was to starve and cut off the supplies, and to place Edinburgh in darkness; and he doubted whether it was advisable that the exact quantity of coal should be stated, so that the railway men might see how long it would be before they could accomplish their object. It was, however, agreed that Mr. Mitchell, the Engineer in Edinburgh, should make a statement; and he said that last week he converted the tank of a gasholder in the works into a tar tank, which gave him additional storeage for tar, to the extent of 415,000 gallons, that on Friday he had 6891 tons of coal, and that on the previous day he got in two short trains of coal. It was reported that there was a three weeks' supply of coal in the Leith works on the preceding Friday; and that since then 24 wagons of coal had been got in. Another discussion of a similar nature was started by Bailie Archibald with reference to the reports of the Law Committee, the subject being initiated apparently with the object of annoying Mr. Macnaughton, who is Convener of that Committee. Subsequently, the subject of the quality of the gas was raised; and a remark by one member, which contained the word impurity, and suggested the use of inferior coal, brought Mr. Mitchell to his feet with a protest. He said there was a mistake. He did not admit that the gas was impure; it was as well purified gas as was produced anywhere. It was not of the same illuminating power as it was for years; but in that he acted strictly in conformity with his Committee's instructions. The reports by the Engineers which were submitted showed that the output of gas from the Edinburgh works during November was 121,328,000 cubic feet; an increase of 16,113,000 cubic feet upon the output in November, 1889. From the Leith works the output was 56,074,000 cubic feet; an increase of 4,001,000 cubic feet over November of last year. In the Edinburgh works, 1548 tons more coals were used than in November last; and the increase in price was £3475. In Leith, 565 more tons were used; and the increase in price was £1554. The Works Committee reported that they had considered the report of a Sub-Committee on automatic stoking machinery; but that, on account of not having ascertained the result of the working of similar machinery at the Aberdeen Gas-Works, they had delayed disposing of the matter and discharged the Sub-Committee. The Sub-Committee approved of the endless wire-rope method of charging and drawing retorts, in preference to the hydraulic system. They also examined Coze's system of inclined retorts at the Southall works of the Brentford Gas Company; and were of opinion that it appeared to work satisfactorily, and that, though the retorts might not be so easily charged with Scotch coal as horizontal retorts, they would be easier drawn. In the opinion of the Sub-Committee, however, the expense of converting the retorts into the inclined system would not be fully compensated for by the accruing advantages. The Sub-Committee did not, in the meantime, favour the introduction of mechanical stoking apparatus with reference to the Edinburgh works, on account of the probability of their removal from the present site, and in the Leith works because of the alterations which would be necessary; but, in the case of Leith, additional retort power will require to be provided before long, and they were of opinion that the question could then be considered in all its bearings.

A tabulated statement giving the business for the past year of the Dundee Gas Commission shows that there was an output of gas amounting to 421,948,000 cubic feet, an increase of 15,607,000 cubic feet over the output in 1889; and that since 1881-82 the output has risen from 342,182,500 cubic feet.

The municipal accounts for the city of Aberdeen for the year 1890 have been published by the Chamberlain. In these, the gas account is stated, as reported in the beginning of November—the revenue being £62,648, as compared with £61,422 in 1889; and the expenditure £58,388, as compared with £52,744. The increase of revenue is accounted for by about £2000 more having been received for residual products, against which there is set off a reduced revenue from the sale of gas to the amount of about £500. In connection with this, it is to be borne in mind that in 1889 meter-rents were abolished; so that the reduced revenue does not mean a diminished output of gas. On the contrary, there was an increase of 8 million cubic feet of gas sold during the past year. The additional expenditure is accounted for by an increase of about £2000 for coal, and an outlay of £3375 for West's stoking machinery being included in the year's accounts. The capital fund account shows that the gas annuities, less the annuity contingent fund, amount to £87,484, as compared with £90,483 in the previous year. This reduction of annuities was effected at a cost of £27,429. In the previous year the sum spent in the redemption of annuities was £24,426. Loans on mortgage were reduced during the year from £46,517 to £42,092; and the value of the gas-works has been reduced from £136,918 to £130,518. The reserve and insurance fund has been raised from £7367 to £7831; and during the year there was a charge upon it of £130 in connection with the loss of the coal barge "Sarah Mills." In the Water Department the revenue was £16,524, and the expenditure £17,775; and the capital account has been reduced from £213,992 to £211,962.

The motion which was sent to the Gas Committee by the Aberdeen Town Council on the subject of the collection of the gas accounts, was considered by them on Monday. The proposal brought forward by Mr. Pratt was that gas accounts should be collected three times a year instead of twice as at present. In support of his proposal, Mr. Pratt mentioned that in Dundee, where the collection is made four times a year, the bad debts amount to 2s. 2d. per cent.; whereas in Aberdeen they amount to 13s. 5d. per cent. Two additional clerks and two extra outdoor employees, it was estimated, would be required if three collections a year were made. The staff at present—collecting £53,000—numbers 20; and in Dundee, where £67,000 is collected, the staff numbers 30. In Dundee, therefore, the cost of collection is much higher in proportion than in Aberdeen. The Committee agreed to continue the system as at present; and went on to consider Mr. Pratt's other proposal, that money securities should be accepted from gas consumers, instead of personal securities as at present. The Committee thought the subject was one which requires careful consideration; and they instructed the City Chamberlain to prepare a report as to what deposits he would require, keeping in view the fact that the accounts are to be collected twice a year, as at present. They also resolved that all money deposits, with 3 per cent. interest, be returned to consumers who have paid their accounts for three years.

From our Glasgow Correspondent.

GLASGOW, *Saturday*.

I am informed that some definite progress has been made towards getting additional gasholder accommodation in connection with the Glasgow Corporation gas supply undertaking. It is stated that the ground which has been secured for the proposed new gasholder is within a comparatively short distance of the Dawsholm gas-works. Efforts are being made, I believe, to so arrange with the proprietors of the conterminous lands that they shall offer no opposition to the project. As has been previously mentioned in my "Notes," the intention of the Gas Committee, acting under the advice of Mr. Foulis, is to erect a holder having a capacity of about five million cubic feet. Such a capacious vessel may require to be 250 or 260 feet in diameter, and 90 or 100 feet in height, in three lifts. It is scarcely expected that such a big holder, with the tank which is to contain it, can be ready for use in less than eighteen months or so, even though all the preliminary details were now settled; and it is not likely that there will be much left out of £100,000 after defraying the cost of such a piece of work, and of the land on which the holder is to be erected.

If the demand for gas in Glasgow and the suburbs should go on increasing in anything like the proportion that has been reached during the past year, there will be greatly increased difficulty in making the present holder capacity meet the wants of the consumers in next December. It is just possible, however, that the third large holder at the Dawsholm works may receive a third lift, like its two neighbours, before the next lighting season has made much progress. It may be also that the same method of adding to the holder capacity will be put in operation at the Dalmarnock or Tradeston works, or at both; and in that way the very pressing difficulty connected with the gas supply during the short and foggy days of next December may be tided over. There has been no end of trouble during the past week, in meeting the demands of the consumers, and many complaints as to want of light have been made in various directions; but these will doubtless become fewer and less pressing with the lengthening of the days.

As regards the difficulty of getting supplies of gas coal owing to the strike among the railway servants, which I referred to in last week's "Notes," the past week has brought about a marked change; and yet in the beginning of the week there was great anxiety in many directions. The strike has lost much of the strain that existed a week ago, and most of the gas-works that were in straits for want of coal, have got relief—in some cases by the railway managers being enabled to run their engines with mineral trains, or by the colliery proprietors supplying their own engines in the emergency. In one or two cases supplies of gas coal were obtained by the Glasgow Gas Committee by sending out locomotive engines from the works to places where the coal was waiting, ready loaded, to have traction power applied. For the Dawsholm works considerable quantities of coal were obtained in the early part of the week by way of one of the branches of the Forth and Clyde Canal, which passes close by the works; the supplies coming from collieries on the line of the canal and within comparatively short distances in the counties of Dumbarton and Stirling. Having thus got much of the strain off his mind, Mr. Foulis is taking a much-needed rest for a day or two at this holiday time at one of the well-known hydropathic establishments on the shores of the Clyde.

In order that there might be something of a definite character to go upon in their prospective negotiations with the Glasgow Corporation Gas Committee for the acquisition of the works of the Partick, Hillhead, and Maryhill Gas Company by the municipal authorities, the Directors of the concern have lately had their whole property, goodwill, stocks, &c., submitted to a fresh valuation—the valuators being Mr. H. E. Jones, Engineer to the Commercial Gas Company, London, and Mr. Joseph Hepworth, Assoc. M. Inst. C.E., Gas Engineer to the Carlisle Corporation. As the result of the valuation, the Directors of the Gas Company have, I am told, indicated their willingness to proceed with the negotiations on the basis of the ordinary and preference stock being represented by the sum of £176,000.

Mention of this Company's affairs leads me to the question of the enormous increase in the demand recently made on their powers of supply. The increase in the deliveries during the past two months has amounted to about 20 per cent.; and there is a great probability that the output of gas over the current financial year will not be far short of 340,000,000 cubic feet, if it does not even exceed that amount. The deliveries during the 24 hours ending at 6 a.m. on Dec. 25 amounted to 2,187,800 feet; whereas the greatest previous delivery over a similar period was 1,980,000 feet. For the make of gas required about Christmas time, there were 282 retorts in use; and there were 84 still in reserve. The manufacturing power of the works, therefore, is much in excess of the demand, great though it be.

On Friday night of last week the employees of the Glasgow Lighting Department held their thirteenth annual festival. Inspector Hamilton occupied the chair; and he was supported by members of the Town Council. The attendance of the workpeople was larger than that of any former gathering of the kind. In the course of his address, the Chairman gave a short comparison of the state of affairs in 1780—when the Glasgow magistrates of the time decided to erect *nine* public lamps in the Trongate—with the extent of the work done by the Department at the present day, with its 400 employees. Bailie Martin delivered a stirring address, in which he referred to the efficiency of the Department, and to the friendly relationship existing between the inspector and the staff. He also congratulated the stairlighters on the increase of wages granted to them since the last annual festival. Altogether, it was a most successful meeting; and notwithstanding the fact that the dancing was kept up for a long time—even past the "wee short hours argant the twal'"—there was not a single report of failure to extinguish in the morning.

Last night week, at Newtown-St.-Boswells, in the south of Scotland, there was given, in connection with the winter course of lectures, a most interesting demonstration in cookery by Miss Isabella G. Elliot, of Edinburgh, diplomée of the Birmingham School of Cookery. A "Main" gas cooking stove had been procured from the Galashiels Gas Company, and was set on a platform in the Baillie Memorial Hall, where an abundant supply of gas was obtained. Lady Grisell Baillie occupied the chair; and there was a good attendance, particularly of those naturally interested in cooking—the circumstance of a public lecture on cooking by the use of gas as the fuel being quite a novelty in the district. At the close of the demonstration, which was very highly appreciated, Lady Grisell Baillie proposed a vote of thanks to Miss Elliot; and said she had seldom passed a more enjoyable evening. The demonstration turned out a great success; and it will doubtless result in an extension of the use of gas cooking-stoves.

Owing to the recurrence of the New-Year holidays, business in the Glasgow pig iron market this week did not continue past mid-day on Wednesday. On Monday there was a lot of bearing; and Scotch iron was run down in price to 46s. 4½d. per ton. When the market closed on Tuesday the price of Scotch warrant iron was 46s. 3d. per ton; that of Cleveland iron being 42s. 3d.; and that of hematite iron being 53s. 6d. per ton. There was a further decline on Wednesday.

The coal trade has been very much disorganized by the holidays, and by the railway strike, with the result that it is difficult to give any correct statement as to prices.

The Quality of the Gas at Crewe.—At last Wednesday's meeting of the Crewe Town Council, complaints were made as to the bad supply of gas to the town by the London and North-Western Railway Company; and several members asserted that the smell of the gas was detrimental to the health of the community. Dr. Hodgson reported that the illuminating power of the gas supplied only averaged 13½ candles; and he thought they might expect a great railway company, with millions of capital, to supply gas of 16-candle power. It was decided to call the attention of the Company to the impurities in the gas, to the smells emitted when it was being consumed, and also to the fact that several of the places of worship in the town could not be properly lighted on account of the inferior pressure.

Fire at the Hope Chemical Works, Hackney.—Last Tuesday will be a memorable day in the history of the Metropolis, from the fact of the outbreak of several very serious fires; one occurring at the Hope Chemical Works, of Messrs. Carless, Capel, and Leonard, in Whitepost Lane, Hackney Wick. When the news of the fire was received at the district station, every available engine was sent on; and as the members of the brigade began to collect, they found they had to deal with an enormous conflagration, which, it was stated, was only excelled by the memorable fire at a petroleum works on the Isle of Dogs some years since. The property attacked covered an area of 250 feet by 90 feet, and consisted of ranges of buildings used as distillery, stores, workshops, offices, &c. Underneath these buildings the oil was stored in great tanks, covered, for purposes of safety, with a layer of clay of considerable depth. Surrounding the premises were rows of somewhat small tenements. The fire burst out in the very centre of the works, while the hands were fully employed, and the mischief made rapid progress. Thanks, however, to the great exertions of the firemen, which the firm have publicly acknowledged, it was confined to the portion of the premises in which it originated; and the contiguous houses, although damaged by water, escaped injury by the more destructive element. Fortunately, the greater part of the stock was saved; and the proprietors announce that there will be no interruption of the business. The damage will, we understand, be covered by insurance.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan.* 3.

Sulphate of Ammonia.—The closing week of the past year was extremely quiet. At this festive season, orders do not generally come in freely; but they seem to have been less than usual—no doubt in consequence of the closing of the ports by ice, and the interruption of the traffic on railways and canals on the Continent. No change is perceptible during the first three days of the New Year; but symptoms are not wanting of an improved demand from the Continent as soon as the weather moderates, while American inquiries continue to come in. The principal business from first hands has been at £10 12s. 6d. f.o.b. Hull; but less has been accepted for some second-hand parcels. Leith is quoted at the same price; but equal to £10 15s. f.o.b. Liverpool seems to have been realized for country parcels. A steadier tone prevails in nitrate, although there is no change in the position.

LONDON, *Jan.* 3.

Tar Products.—No new business of any magnitude has been reported during the past week. Benzols are firm; and for spot delivery as much as 4s. 8d. for 90's can be obtained. A decided "squeeze" took place at the end of the year to make up arrears, which, it is stated, are in some instances unusually large, makers having oversold themselves. Pitch is steady, and very large shipments are going on; but as the season advances, there is an inclination to ease in this direction. Creosote and common oils are in excellent request for illuminating purposes; while timber picklers have been also extremely busy. There are comparatively small stocks, although this is the heaviest season for production. Carbolic is weak and not easy to sell. It is stated, however, that little or no stock of this article exists. Anthracene is somewhat flat; very little inquiry being made for it—buyers no doubt being well covered. To-day's prices are: Tar, 30s. Pitch, 35s. Benzol, 90 per cent., 4s. 8d.; 50 per cent., 3s. 6d. Toluol, 2s. Solvent naphtha, 1s. 9d. Crude naphtha, 1s. 8d. Creosote, 2¼d. Heavy oil, 3d. Crude carbolic, 60's, 1s. 6d. Cresol, 9d. Anthracene (30 per cent.), "A" quality, 1s. 4d.; "B" quality, 1s. 1d.

Sulphate of Ammonia.—This market continues dull; and buyers still hold aloof. The price is to-day exceptionally low; and home consumers are likely to buy largely, if prices do not advance. Business is reported at prices ranging from £10 7s. 6d. to £10 12s. 6d., according to position and delivery. Ammonia liquor is quotable at 6s. to 7s., according to position and quality.

Lancashire Coal Trade.—The business continues brisk, and there are plenty of orders to be had at last week's rates. Several large May to June contracts have been sealed at 6d. to 1s. per ton rise upon last prices. Corporations and gas companies obtained substantial reductions in the coal contracts entered into last week for the ensuing quarter and half year. At the pit's mouth, best coal averages 12s. 6d. per ton, with 11s. for seconds; and 9s. to 9s. 6d. for the commoner descriptions. Burgy is quoted from 7s. 6d. to 8s. per ton; best slack, 6s. 9d. to 7s. 6d. and commoner sorts about 5s. 6d.

Messrs. Robert Dempster and Sons, Limited.—The third ordinary general meeting of this Company was held on Monday, the 22nd ult., at the London Offices—the Hon. J. B. Roche in the chair. The Secretary (Mr. G. J. Gray) having read the notice convening the meeting, the Chairman moved the adoption of the report and accounts. Mr. T. H. Lambert seconded the motion, and it was carried unanimously. The retiring Director (Mr. Lambert) and the Auditors (Messrs. J. Hardcastle and Co.) were re-elected; and the business of the ordinary meeting terminated. An extraordinary general meeting was then held at which resolutions making certain alterations in the Articles of Association were unanimously passed; and the proceedings closed with a vote of thanks to the Chairman.

Proposed Extensive Oil-Works at Sunderland.—At a meeting of the River Wear Commissioners at Sunderland last Wednesday, an application was considered from the Anglo-American Oil Company for permission to lay pipes through the dock lands for the transmission of burning oil from oil-carrying vessels to works intended shortly to be constructed at Hendon. In order to obviate any possibility of danger arising from the conveyance of the oil, the Company undertook to lay the pipes at some distance beneath the surface of the ground. The works will be built in close proximity to the North-Eastern Railway, to admit of the oil being more easily distributed to all parts of the kingdom. The Commissioners agreed to grant the necessary permission for a nominal acknowledgment of £5 per annum.

Electric v. Gas Lighting at Barnet.—The efficiency of the electric lighting at Barnet has been a subject of controversy ever since the system was introduced. Now the ratepayers are beginning to consider the expense as compared with gas. As various statements have been put forward on this matter, a local paper has given the following figures as an exact record of the cost of the public lighting before and since the introduction of electricity: *Gas.*—1884, £294 1s.; 1885, £324 11s. 4d.; 1886, £328 12s. 6d.; 1887, £380 8s.; 1888, £338 2s. 9d. *Electric Light.*—Amounts paid in 1889: Jan. 5, £89 14s.; April 23, £90; June 22, £95 17s.; Sept. 6, £95 17s.; Dec. 21, £94 12s. Amounts paid in 1890: March, £95 17s.; June, £99 4s. 6d.; Sept. £99 4s. 6d.; Dec. 20, £96 6s. It is stated, by way of explanation, that in the sums for electric lighting are included a few lamps in roads, where there were no gas-lamps. On the other hand, it should, in fairness, be stated that the electric lamps are fewer in number than the gas-lamps, and that to the sum charged for electric lighting must be added the cost of gas-lamps which are paid for by the Local Board in addition. It is also pointed out that the cost of electric lighting would have been still greater but that deductions have at times been made in consequence of defects. Members of the Board who favour the continuance of the electric light, argue from the figures that, taking all things into consideration, the electric lighting is, by comparison, cheaper than the gas lighting. The ratepayers can draw their own conclusions from the figures.

The Limerick Corporation and Electric Lighting.—In order to aid them in their opposition to the application of the Irish House-to-House Electric Lighting Company for powers to supply electricity in the borough, the Limerick Town Council have resolved to take steps to obtain a Licence for a similar purpose.

Companies Wound Up in the Past Year.—The following Companies were wound up voluntarily during the past year: Australasian Electric Light, Power, and Storeage Company; Burley-in-Wharfedale Gas Company; City of Potsdam Water-Works Company; Clamond Incandescent Gas-Light Company; Gas Enriching Company; Gringley-on-the-Hill Gaslight and Coke Company; Lawrence Gas Company of Lancashire and Cheshire; Lawrence Automatic Gas Company; Lindfield Gaslight and Coke Company; Maxim Weston Electric Company; Rayleigh Gas and Coke Company; South Barracas (Argentine) Gas Company; Tenby Oil Lighting and Heating System Syndicate; Universal Water Power Company; Wenlock Gas Company; Whitehall Electric Supply Company; Wivenhoe Gas Company; Woodhouse and Rawson Electric Contract and Maintenance Company. Three other Companies—the Condal Water Company, the Lothammer Gas Company, and the Staffordshire Gas and Coke Company—were wound up under Orders of the Court.

A Claim for Compensation against the Leeds Corporation Water Committee.—The Leeds Corporation are now carrying out certain important works at Eccup with the object of strengthening and deepening the embankment at the end of the reservoir near the estate of Lord Harewood. These works include the excavation of a trench in the embankment, and certain pumping operations, in respect of which Lord Harewood made a complaint to the Committee that they were causing him considerable damage and annoyance, for which he would claim compensation. A large amount of correspondence took place on the subject; and ultimately the matter was referred by the Water Committee to a Sub-Committee, with instructions to negotiate with Lord Harewood with a view to a settlement of his claim. The Sub-Committee devoted considerable time and attention to the matter; and an arrangement was arrived at, which, however, had to be submitted to the General Committee for approval. A special meeting of this Committee was held last Friday, when, after considerable discussion, the provisional agreement was almost unanimously agreed to. The terms of the arrangement, it is understood, involve the payment of £2000 to his Lordship, and the expenses incurred. The amount to be paid is to cover the damage up to July 1 last. It was further agreed that £50 per week should be allowed so long as the works might be continued.

The Dangers of Electric Light Wires.—A great deal was made a short time since, by some of the newspapers, of the fact that the electric light had gained a footing in the Celestial Empire; but following closely upon the record of its introduction, comes a report of an accident in connection with it. We learn from the *Shanghai Mercury* that, on the night of the 8th of November last, one of the foreign operators in the Great Northern Telegraph Office was nearly blinded, touching a transmitter, by a flash of huge electric sparks issuing therefrom. An investigation of the cause revealed the fact that, owing to the unsatisfactory method adopted by the electricians in stringing up their wires, one of them ran in close proximity to the telegraph lines, to one of which it had actually been tied with a piece of string to prevent it "sagging." During the prevalence of dry weather no evil consequences ensued; but a shower converted the string into a conductor, and the powerful current required for the lighting was thereby diverted into the telegraph line. Had this line been at work, the operator might have been killed and serious damage done to the office. As it was, there was only a couple of hours' delay in the service. The matter has been brought before the Municipal Council in a joint letter from all the telegraph authorities, apprising them of the danger arising from want of proper supervision over the stringing of the wires, and submitting for their consideration an abridgement of the Board of Trade rules on the subject.

The Proposed Purchase of the Ystrad Water-Works by the Local Authority.—In consequence of the Ystrad Sanitary Authority having applied to the Local Government Board under section 48 of the Ystrad Gas and Water Works Act, 1890, for their consent to the giving of notice to the Ystrad Gas and Water Company of the proposed purchase of the water-works, Colonel W. M. Ducat, R.E., held an inquiry at Pentre last Tuesday. Mr. Stewart, on behalf of the Local Board, made a statement, from which it appeared that in 1868 the Company obtained parliamentary powers to construct two reservoirs in the valley; but they had allowed those powers to lapse. In 1890 they obtained further powers to construct filter-beds and tanks and a reservoir, and to impound additional streams; and he believed that, since the passing of the Act, the proposed works were being carried out. The capital of the Company in 1889 was £72,490; and an additional £70,000 had been borrowed to carry out new works. The revenue accruing from the rates derivable from the consumers would not repay the outlay if purchased by the Board; and, consequently, a very considerable sum would have to be imposed on the joint district rate to supply the deficiency of the revenue from the water-works. The Board, therefore, would prefer not to buy the works if the Company unfailingly supplied the district with a satisfactory quantity of pure and wholesome water. The Company had stated that they were quite prepared to take into consideration any offer the Board might think proper to make for the works. Mr. Griffith Thomas produced two or three bottles of muddy water, which, he said, were samples of what the Rhondda people had been drinking for years past; and some dirty wool was also produced, which was said to have been picked up out of the stream from which the Company obtained their supply. The Medical Officer to the Board (Dr. James) deposed that the Company had violated the Acts of Parliament hundreds of times during a number of years; and that they had no storeage, though the population supplied was about 60,000. Mr. G. Rees, the Engineer of the water-works, stated that two additional filters and a capacious service tank were now being constructed; and, after their completion, the Company would be able to supply 600,000 gallons of pure and wholesome water daily. Plans were also being prepared for the construction of storeage works. Before the proceedings terminated, representatives from Porth and Rhondda Vach objected most positively to the Board purchasing the works.

Messrs. Kirkham, Hulett, and Chandler, Limited, have recently received an order from the Birmingham Corporation for their improved patent devices to be fitted to the large "Standard" washer at the Windsor Street works. The firm have also recently erected one of their new patent "Standard" washers at the Kensal Green station of The Gaslight and Coke Company, and others elsewhere.

Long Eaton Water Supply.—Last Wednesday, Colonel Hasted, R.E., one of the Inspectors of the Local Government Board, held an inquiry at Castle Donington, with regard to an application by the Shardlow Rural Sanitary Authority to borrow £2000 to provide a supply of water from the Long Eaton Local Board. There was considerable opposition; and much interest was taken in the proceedings.

The Heywood Chemical Company, Limited, is the title of a Company formed with a capital of £50,000, to carry into effect an agreement made on the 13th ult., between Rupert G. Williams and Charles F. Fuller, "to carry on the business of manufacturers of azamine, or any other dyes or colours, and generally to carry on the business of manufacturing chemicals." Among the first subscribers to the Company are Messrs. Greville Williams and L. G. Williams, of the Aniline Dye-Works, Hounslow.

The Southwark and Vauxhall Water Company's Bill.—By the Bill which has been deposited by the Southwark and Vauxhall Water Company, Parliament will be asked to authorize the Company to raise, by auction or by tender, an additional £300,000 of 4 per cent. debenture stock, to meet "the continuous outlay of capital" required in consequence of the increasing population in their district. The Bill contains a clause for the creation of a sinking fund, "to be held and applied by the Chamberlain of the City of London, as trustee, for the purpose of purchasing and extinguishing the share capital of the Company, or for such other purposes as Parliament may from time to time determine." The nucleus of this fund is to be the difference in the percentage between the interest on the above mentioned debenture stock, *plus* 1 per cent. for management expenses, and the average dividend paid on all the share and loan capital of the Company. Our readers may remember that a clause of the nature of the foregoing was inserted in an Act obtained by the East London Water Company in 1886.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 12.)

Issue.	Share	When ex-Dividend.	Dividend on Ordy. Basis.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Oct.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	,,	7½	Do. 7 p. c.	10	12—13	..	5 15 6
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	105–107*	+½	4 13 5
100,000	20	27 Nov.	8	Bahia, Limited	20	17—19	..	8 8 5
200,000	5	13 Nov.	7½	Bombay, Limited	5	6¾—7¼	..	5 3 5
40,000	5	,,	7½	Do. New	4	5—5½	..	5 9 1
380,000	Stck.	14 Aug.	12½	Brentford Consolidated	100	212—217	..	5 12 11
125,000	,,	,,	9½	Do. New	100	155—160	..	5 15 7
220,000	20	11 Sept.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
320,000	20	28 Mar.	11½	British.	20	43—45	..	5 0 0
50,000	10	11 Sept.	11	Bromley, Ordinary 10 p. c.	10	18—20	..	5 10 0
39,000	10	,,	8	Do. 7 p. c.	10	13—14	..	5 14 3
328,750	10	13 Nov.	6	Buenos Ayres (New) Limited	10	11—12	..	5 0 0
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	101–104*	+1	5 15 6
150,000	20	14 Aug.	8	Cagliari, Limited	20	26—28	..	5 14 3
550,000	Stck.	10 Oct.	13⅜	Commercial, Old Stock	100	250—254	..	5 8 3
130,000	,,	,,	10⅔	Do. New do.	100	198—203	..	5 5 11
130,000	,,	30 Dec.	4⅜	Do. 4½ p. c. Deb. do.	100	117–122*	+½	3 13 9
557,320	20	30 Dec.	13	Continental Union, Limited	20	47—49*	..	5 6 2
242,680	20	,,	13	Do. New '69 & '72	14	32½—33½*	..	5 8 5
200,000	20	,,	10	Do. 7 p. c. Perf.	20	37—39*	..	5 2 6
75,000	Stck.	25 Sept.	10	Crystal Palace District	100	195—205	..	4 17 7
234,060	10	16 July	—	European, Limited	10	19—20	..	—
120,000	10	,,	—	Do. New	10	19—20	..	—
354,060	10	,,	—	Do. do.	7½	13½—14½	..	—
5,470,620	Stck.	14 Aug.	13	Gaslight & Coke, A, Ordinary	100	240—245	+4	5 6 1
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	98—101	..	3 19 3
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	251—256	+2	3 18 1
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	120—125	+1½	4 0 0
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	177—182	..	4 2 5
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	164—168	..	4 3 4
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	248—253	+1	3 19 0
176,000	,,	—	—	Do. K, 6 p. c. Prf.	100	147—152	..	3 19 0
1,061,150	,,	12 Dec.	4	Do. 4 p. c. Deb. Stk.	100	111—116	..	3 9 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	121—126	..	3 11 5
650,000	,,	,,	6	Do. 6 p. c. do.	100	158—162	..	3 14 1
3,800,000	Stck.	13 Nov.	12	Imperial Continental	100	220—225	..	5 6 8
75,000	5	12 Dec.	6	Malta & Mediterranean, Ltd.	5	5—5½	..	5 9 1
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	100	110—112	+1	4 9 8
541,920	20	27 Nov.	6⅔	Monte Video, Limited	20	18¾—19¾	..	6 13 4
150,000	5	27 Nov	10	Oriental, Limited	5	8¾—9¼	..	5 8 1
60,000	5	25 Sept.	7	Ottoman, Limited	5	5—5⅜	..	6 7 3
166,870	10	16 July	4	Pará Limited.	10	3—4	..	10 0 0
420,000	100	3 Nov.	6	People's Gas of Chicago— 1st Mtg. Bds.	100	95—100	..	6 0 0
500,000	100	1 Dec.	16	2nd Do.	100	93—98	..	6 2 5
150,000	10	10 Oct.	10	San Paulo, Limited	10	15—17	..	5 17 8
500,000	Stck.	28 Aug.	13½	South Metropolitan, A Stock	100	280—285	..	4 12 11
1,350,000	,,	,,	11¼	Do. B do.	100	228—233	..	4 18 9
141,500	,,	,,	2	Do. C do.	100	235—245	..	4 17 11
650,000	,,	30 Dec.	5	Do. 5 p. c. Deb. Stk.	100	140–145*	+½	3 9 0
60,000	5	11 Sept.	11½	Tottenham & Edm'nton, Orig.	5	11—13	..	4 8 5
				WATER COMPANIES.				
729,221	Stck.	30 Dec.	10	Chelsea, Ordinary	100	267–272*	..	3 13 6
1,720,560	Stck.	10 Oct.	7½	East London, Ordinary	100	213—218	..	3 8 10
544,440	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	140–145*	+½	3 2 0
700,000	50	12 Dec.	9	Grand Junction	50	117—122	..	3 13 9
708,000	Stck.	14 Aug.	10½	Kent	100	273—278	..	3 15 6
1,043,800	100	30 Dec.	9½	Lambeth, 10 p. c. max.	100	245–250*	+½	3 16 0
406,200	100	,,	7½	Do. 7½ p. c. max.	100	195–200*	+½	3 15 0
260,000	Stck.	25 Sept.	4	Do. 4 p. c. Deb. Stk.	100	120—124	..	3 4 6
500,000	100	14 Aug.	12½	New River, New Shares	100	360—365	..	3 6 5
1,000,000	Stck.	31 July	4	Do. 4 p. c. Deb. Stk	100	125—128	..	3 2 6
902,300	Stck.	12 Dec.	7	S'thwk & V'xhall, 10 p. c. max.	100	175—180	..	3 17 9
126,500	100	,,	7	Do. 7½ p. c. do.	100	167—172	..	4 1 4
1,155,066	Stck	12 Dec.	10	West Middlesex.	100	260—265	..	3 15 0

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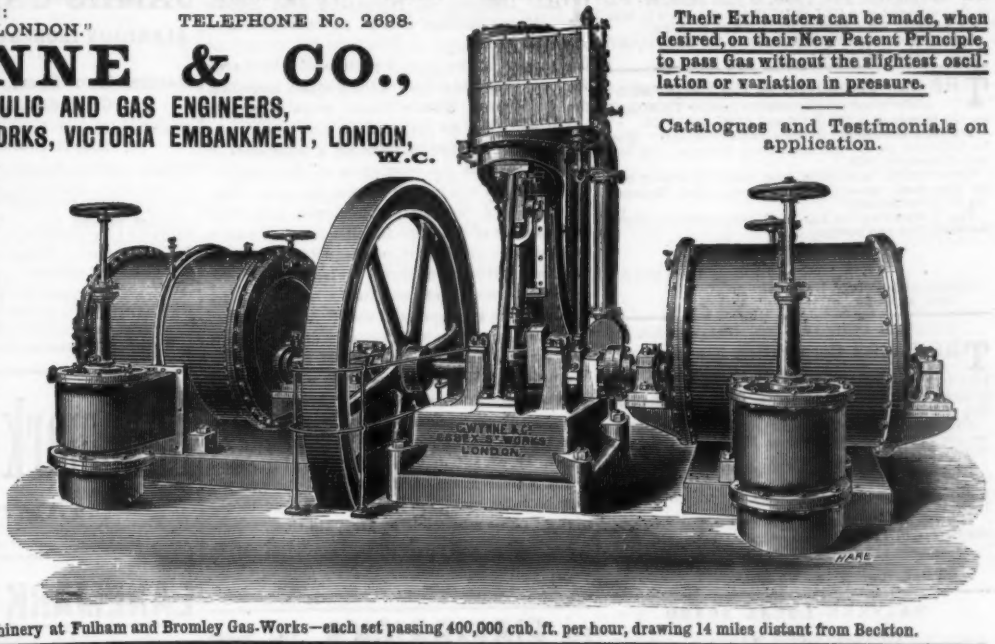

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EXTRACT from the Harrogate Gas Company's Report, dated the 5th of February, 1890: Coal consumed, 9600 tons. Gas made, 92,880,000 feet; ditto sold, 84,980,000 feet; ditto unaccounted for, 8,000,000 feet; quantity made per ton, 10,800 feet; ditto sold, 9869 feet. Illuminating Power, 16·1 candles. Coals used, Brancepeth. Owners, Strakers and Love, Newcastle-on-Tyne; who have also Brandon Hutton Seam Unscreened Gas Coal. Analysis, 10,500 cubic feet per ton; Illuminating Power, 16·2 candles.

COZE'S Automatic Apparatus for CHARGING AND DISCHARGING GAS-RETORTS. For Illustrated Advertisement of this System, see p. 40.

Inquiries should be addressed to THE AUTOMATIC COAL-GAS RETORT COMPANY, LIMITED, 86-88a, LEADENHALL STREET, E.C.

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*** See Advertisement p. 1263 of last week's issue.

Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

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Telegraphic Address: "Braddock, Oldham."

IRISH Bog Ore for Gas Purification. The very best imported. Sample Trucks sent from Depôt at Runcorn.

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DRAUGHTSMAN, having been engaged upon Plans and in Superintending the carrying out of Work in connection with enlargements and extensions at a Corporation Gas-Works, is desirous of similar EMPLOYMENT. Good Draughtsman, experienced, and practical. First-class testimonials.

Address No. 1893, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, immediately, a sober steady Man as STOKER. Constant employment to a suitable Man.

Apply to J. P. POOLE, Gas-Works, Sutton and Hooton, CHESHIRE.

WANTED, a Gas-Meter Repairer. Wages to commence at 28s. per week. Hours, 7 a.m. to 5.30; Saturdays, 12.30. To an efficient, handy, expeditious Man, this will be a permanency; an indifferent one need not apply.

State age and full capabilities, with reference, to the MANAGER, Gas-Works, BRIGHLINGTON.

WANTED, a Working Foreman, able to control Men. Must have had good experience in Carbonizing and the General Work of a Gas-Works, and competent to do the ordinary Fitting and rough Smithing required, and to take charge of the Works in the absence of the Manager. Wages, 30s. per week, with Cottage, Coal, and Gas.

Apply, by letter, before the 18th of January next, stating age and whether married or single, and enclosing references, to

S. CARPENTER, Manager.
Gas-Works, Dorking.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application. Spent Oxide and Sulphate of Ammonia purchased.

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JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

HUTCHINSON BROTHERS, Barnsley, Gas Engineers and Contractors, Makers of Wet and Dry Gas-Meters and General Gas Apparatus, Sulphate of Ammonia Plant, Lead Saturators, Tanks, &c., Tools and Sundries.

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Address, stating price per ton and quantity, No. 1766, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Seven Purifiers, 15 feet square, with Sieves, Connections, Valves, and Lifting Apparatus complete.

One PURIFIER, 20 ft. by 16 ft., with Sieves, Connections, Valves, and Lifting Apparatus complete.
Two Wrought-Iron TANKS, 8 feet diameter by 7 feet and 6 feet respectively.
One REID'S GAS WASHER.
Two Cast-Iron TANKS, 15 ft. 8 in. diameter by 11 ft. 4 in. and 8 ft. 6 in. respectively.
Two EXHAUSTERS (Jones), equal to 25,000 cubic feet per hour.
A number of 15-inch and other VALVES.
A quantity of SHAFTING and PULLEYS.

J. HEPWORTH.
Gas-Works, Carlisle,
Nov. 14, 1890.

SPENT OXIDE.

THE Gas Committee of the Bury Corporation invite TENDERS for the purchase of about 150 tons of SPENT OXIDE.

Samples and form of tender may be obtained on application to the undersigned.

Tenders, endorsed "Spent Oxide," must be sent to me not later than Monday, the 26th inst.

W. H. S. GENDALL,
Engineer and Manager.
Gas Offices, Elton, Bury.

A New 24-inch Centre-Valve (dry-faced) to work One, Two, Three, or Four Purifiers; also strong wrought-iron CYLINDER, 6 ft. diameter by 30 ft. long, suitable for Scrubber. TO BE SOLD cheap.

Apply, by letter, to No. 1895, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Gas Committee of the Corporation of Heywood are prepared to receive TENDERS for the supply of RETORTS and FIRE-BRICKS.

Tenders, endorsed "Retorts and Fire-bricks," must be delivered to me not later than Tuesday, the 13th day of January, 1891.

Specification, quantities, and form of tender may be obtained upon application to the Manager, W. W. Whatmough.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
ALFRED WALLIS,
Town Clerk.

Municipal Buildings, Heywood,
Dec. 30, 1890.

HALIFAX CORPORATION GAS-WORKS.

THE Halifax Corporation are prepared to receive TENDERS (*a*) for the supply of SULPHURIC ACID and OXIDE, and (*b*) for the purchase of SPENT OXIDE OF IRON for the year ending the 31st of December, 1891.

Full particulars and forms of tender may be obtained on application to Mr. Thomas Holgate, F.C.S., Gas-Works, Halifax.

Sealed Tenders, endorsed "Sulphuric Acid," "Oxide," or "Spent Oxide," as the case may be, to be delivered to the undersigned not later than the 8th of January, 1891.

The Corporation do not bind themselves to accept the lowest, highest, or any tender.

KEIGHLEY WALTON,
Town Clerk.

Town Hall, Halifax, Dec. 24, 1890.

MALVERN LOCAL BOARD.

TO GASHOLDER MAKERS.

THE Malvern Local Board are prepared to receive DESIGNS, DETAILED SPECIFICATIONS, and TENDERS for the construction and erection of a DOUBLE-LIFT GASHOLDER, COLUMNS, GIRDERS, &c., complete, or for any new method of construction.

The conditions and specification can be seen at the Office of Mr. John E. Palmer, Surveyor and Gas Manager to the Board.

The Gasholder Tank is 72 feet diameter and 21 feet deep.

The Drawings, showing the methods of construction proposed, and Specification, must be supplied free of cost to the Board.

The tenders, drawings, and specifications are to be sent to the Clerk of the Local Board on or before Monday, the 19th of January, 1891, endorsed "Tender for Gasholder."

The Board do not bind themselves to accept the lowest or any tender.

WM. LAMBERT,
Clerk to the Board.

Local Board Offices, Malvern,
Jan. 1, 1891.

FOR DISTRIBUTION WITH GAS ACCOUNTS.

A 4pp. Leaflet, entitled "The Use of GAS-STOVES IN OUR HOMES;" being a reprint of an article from the *Home Provider*. Price 3s. 6d. per 100. Special quotations for larger quantities, and, if required, for printing Gas Company's own announcement on first or last page. Specimen copy, free by post, 1½d.

May be obtained of S. H. E. FOXWELL, Office of the *Home Circle and Provider*, 48, Temple Chambers, TEMPLE AVENUE, E.C.; and of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

Price 2s. per dozen, or 10s. 6d. per 100, post free.

CONSPIRACY and Protection of Pro-perty Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

*** *The Act extends to Scotland and Ireland.*

MR. W. H. BENNETT having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Inventions may be secured for Twelve months; or LETTERS PATENT, which are granted for Fourteen Years.

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Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

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THE Owners of Holmside and South Moor Collieries possess an undivided area of nearly 5000 acres of COAL in the County of Durham, over the greater portion of which area the most of the best Coal of the district, including the well-known Hutton Seam, remains almost untouched; and as preparations are being made for working the Hutton Seam on a large scale, it is expected that the reputation of HOLMSIDE GAS COALS will be still further increased. The Holmside and South Moor Collieries have been in the hands of the same families for over half a century; but, until lately, no adequate attempt has been made to open out their very large Coal-Field, notwithstanding that the best Coal of the district around them, and especially the Hutton Seam, has been for some time past seriously diminished by reason of the vigorous workings of neighbouring coal-owners. Holmside Gas Coals are now being worked out of Holmside and South Moor Collieries at a rate of about 2200 tons per working day—a rate totally inadequate to meet the existing demand. By an extensive development of workings in the Hutton Seam, it is hoped that the demand may be fully met, and the quality raised to the highest point attainable by Durham Coal.

For price and particulars, apply to MARK ARCHER, Holmside and South Moor Offices, Quayside, NEWCASTLE-ON-TYNE.

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Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

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Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
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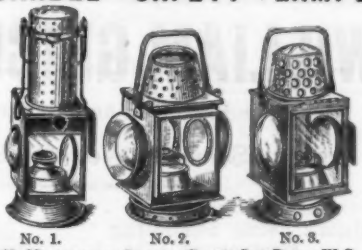

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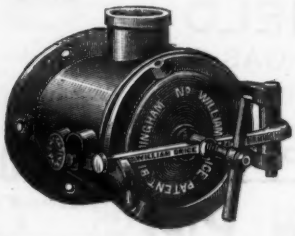

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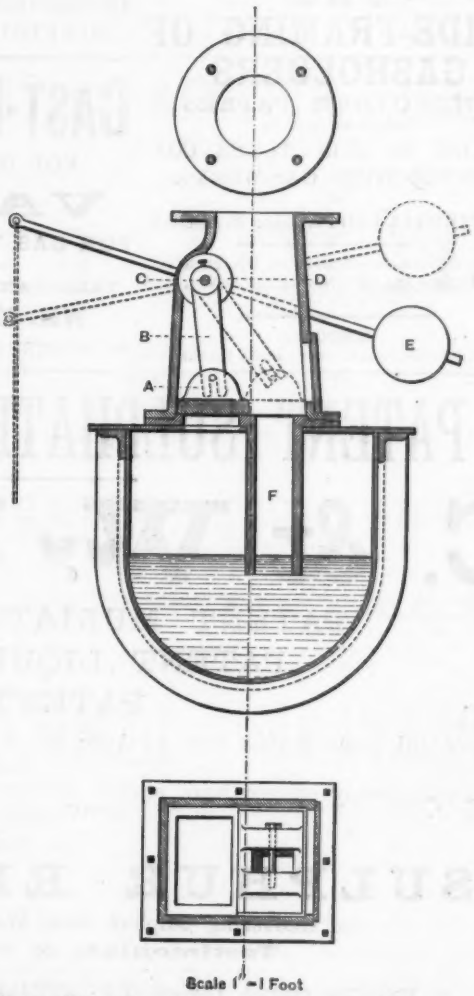
SIR,—I have examined your patent Anti-Dip arrangement, and have seen it at work on the Retort-Benches, at the Longwood Gas-Works, and the opinion which I have formed of its simplicity and certainty in working is distinctly favourable; so much so *that I consider it to be, without exception, the most efficient Appliance of the kind which has yet been introduced.* It can be applied to existing Benches with great ease, and at a minimum cost. So far as I am aware, it embodies a principle of action not previously applied in this direction.—Yours truly,

THOS. NEWBIGGING.



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Has all the advantages of the Dip and Anti-Dip combined.
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Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,

Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.

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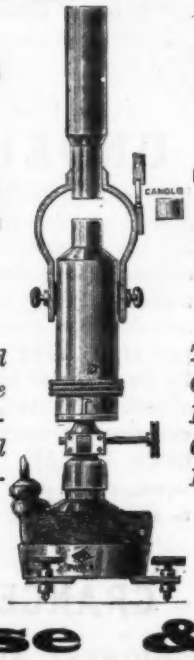

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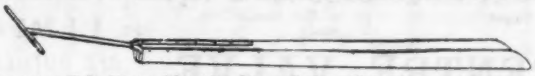

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Compiled and arranged by ALFRED LASS, *Fellow of the Institute of Chartered Accountants.*

LONDON:

WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

MIDLAND DISTRICT OFFICE: 22, TEMPLE ST., BIRMINGHAM—SOLE AGENT: A. C. SCRIVENER.

TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE NO. 200.

LONDON DISTRICT OFFICE: 6, STRAND, LONDON—C. PARKER & SON, SOLE AGENTS.

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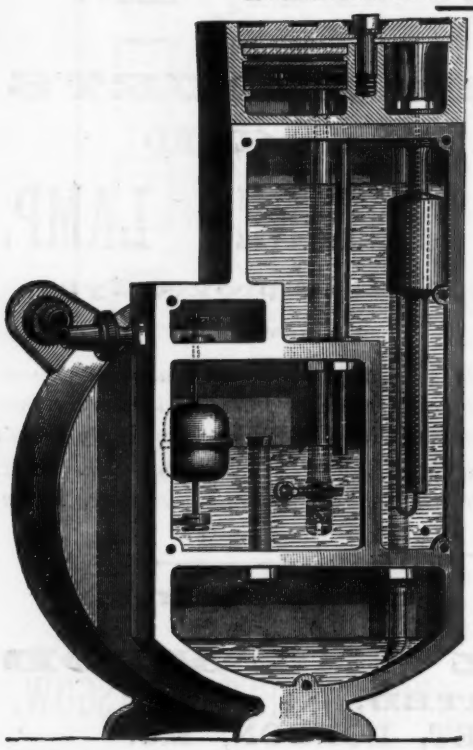
ALDER AND MACKAY,

MANUFACTURERS OF

IMPROVED WET AND DRY GAS-METERS

IN CAST-IRON AND TIN CASES OF THE HIGHEST EXCELLENCE.



Sole Makers of Green's Patent Underground Wet Gas-Meters for Street Lighting, &c., and Ogden's Patent Spindle Tube for Wet Gas-Meters.

GREEN'S PATENT

UNDERGROUND METER

Has been designed to obviate that which has hitherto prevented the general adoption of underground Meters—namely, their serious cost. No box is required, and the saving thus effected as compared with ordinary underground Meters, where either a box or meter-pillar is necessary, is fully one-half. The price of one for three lights is 28s., and the other sizes are correspondingly cheap. When fixed, the only part of the Meter exposed to view measures 6½ inches by 8½ inches. By the Indicator with which the Meter is fitted, the Inspector can at once discern whether water is required; but as the Meter is of the compensating description, water will probably need only be supplied ONCE A YEAR. It is advisable to fill the Meter with a non-freezing liquid, which does not injure the fittings; and this can be supplied at about 1s. per gallon.

Prices and all Information on Application.

GRANGE WORKS, EDINBURGH.

HIGHEST AWARDS given for our WET and DRY METERS at

Exhibitions held at GLASGOW, CALCUTTA, and EDINBURGH.

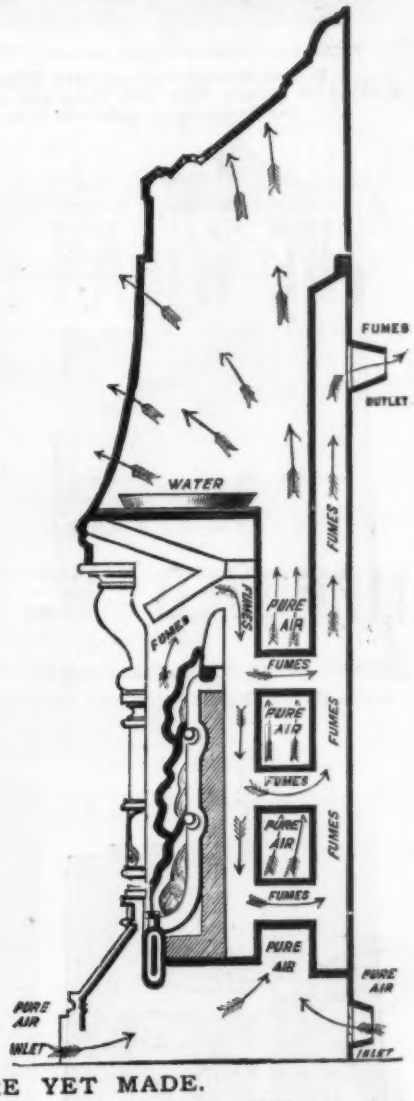
ONLY GOLD MEDAL Food and Cookery Exhibition, 1890.

H. DARWIN & CO., LIMITED,

GAS FIRE AND STOVE MANUFACTURERS.

THE "DARWIN"

CALORIC GAS-FIRE.



NEAREST APPROACH TO A COAL FIRE YET MADE.

Elegant in Design. **PATENT FIRE.** *Silent Jet.*

PRICES.	No. 1.	No. 2.	No. 3.
Best black finished	£2 5 0	£2 15 0	£3 5 0
Top Panels Electro Nickelled, Brassed, or Copper Bronzed	2 15 0	3 7 0	4 0 0
Top Panels and Sides do.	3 3 0	3 15 0	4 8 0
Stove all do.	3 10 0	4 5 0	5 0 0

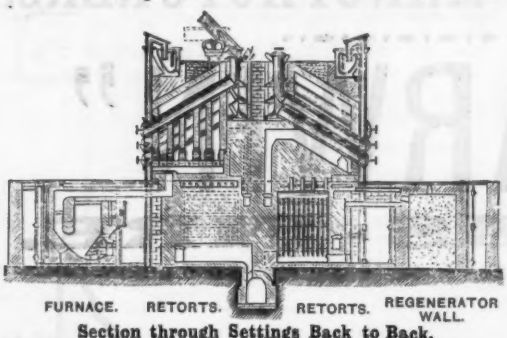
With Hand-Painted Tiles, 10s. to 20s. extra.

ST. ANDREW'S WORKS, 618 to 622, EGLINTON STREET, GLASGOW.

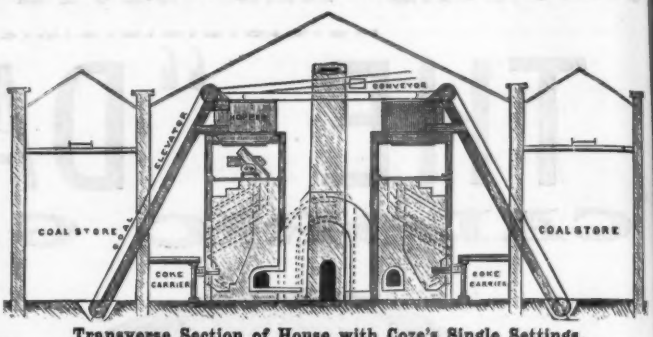
AUTOMATIC SYSTEM OF
CHARGING & DRAWING INCLINED GAS-RETORTS.

Gold Medal, Paris Exhibition, 1889.

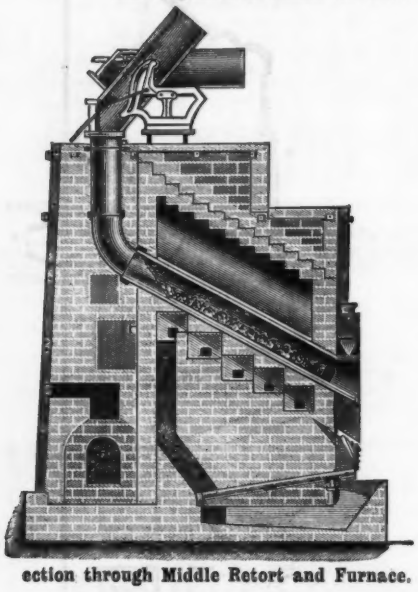
This System of Automatically Charging and Discharging Retorts without machinery or arduous labour is in operation at several places on the Continent and in America, and will shortly be at work in various Gas-Works in England.



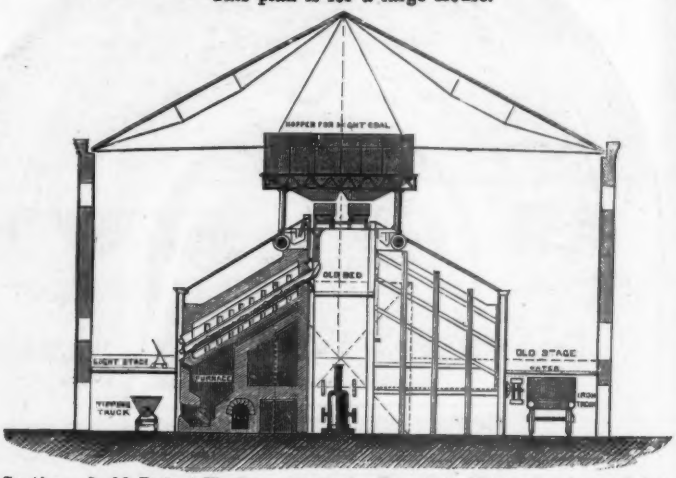
Section through Settings Back to Back.
Working off ground floor with Generator under Stage and Regenerator under the Sets.



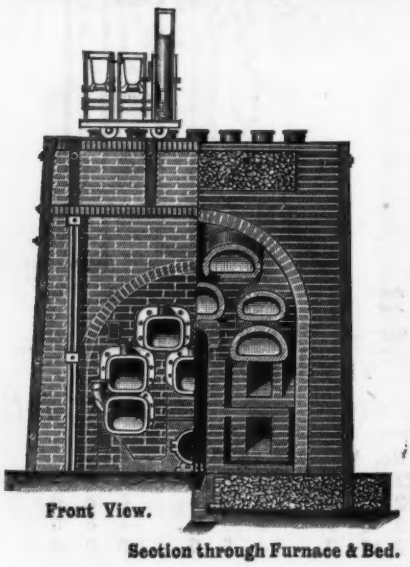
Transverse Section of House with Coze's Single Settings, Showing Method of working Two Single Settings and Distributing the Coal to the Supply Hoppers; the whole of the work being Automatic. This plan is for a large House.



ection through Middle Retort and Furnace.

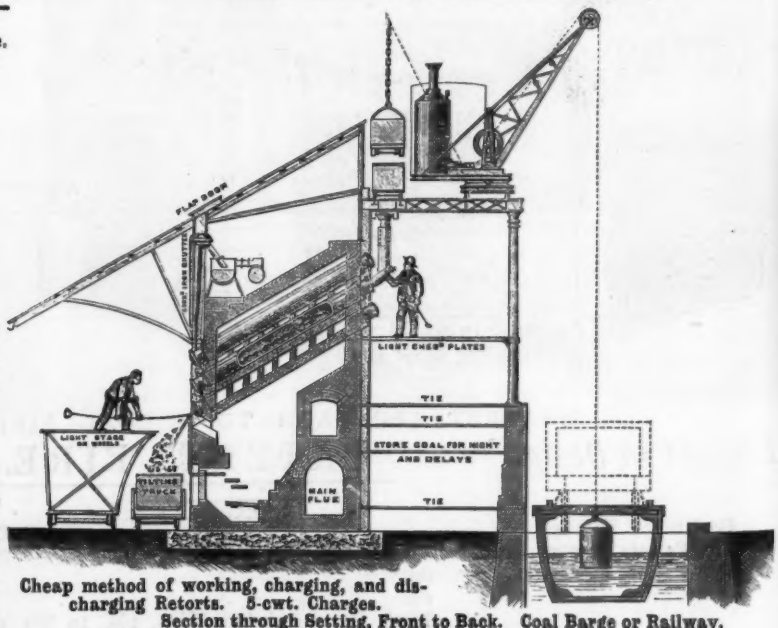


Section of old Retort-House converted, Two Sets 20 fts. in place of One. Modified form, with ordinary Retorts and Fittings.



Front View.

Section through Furnace & Bed.



Cheap method of working, charging, and discharging Retorts. 5-cwt. Charges.
Section through Setting, Front to Back. Coal Barge or Railway.
Light Corrugated Roof over Sets and at Sides.

These Systems are fully Patented, and any Infringer will be strictly proceeded against.

For further particulars apply to W. M. KIGHT, Secretary of THE AUTOMATIC COAL-GAS RETORT COMPANY, LIMITED, 86 and 88A, LEADENHALL STREET, LONDON, E.C.

"THE METEOR."

NEW HIGH-POWER GAS-LAMP.

Westphal's Patent.

Gas Companies should hire these Lamps to their Consumers, and introduce them for Street Lighting as a rival to the Electric Light, as they do not get out of order, are most economical, and the Burner being a circular slit does not choke up.

Particulars and Prices Free.

HENRY GREENE & SONS,

SOLE CONSIGNEES FOR GREAT BRITAIN & COLONIES,
153 TO 155, CANNON STREET,
LONDON BRIDGE, E.C.

TELEGRAPHIC ADDRESS: "GAS LEEDS."

CLAYTON, SON, & Co.

LONDON OFFICE: 60, QUEEN VICTORIA STREET, E.C.

LIMITED,
LEEDS,
MAKE

RETORT LIDS

OF ALL FORMS AND SHAPES
IN IRON OR STEEL
BY SPECIAL HYDRAULIC
MACHINERY.

PRICES ON APPLICATION.

FIRE BRICKS,
LUMPS, TILES,
BLOCKS, &c.

Special Bricks for Intense Heats.

GAS RETORTS.

CASTINGS AND EVERY REQUISITE FOR GAS-WORKS.

MOBBERLEY & PERRY,
Fire-Brick Works, STOURBRIDGE.

☛ **Retort Setters sent to any part of the Kingdom.**

G. J. EVESON,

GAS COAL AND CANNEL CONTRACTOR,

PATENTEE OF

A SPECIAL COMPOUND

FOR THE CURE OF STOPPED ASCENSION-PIPES,

A couple of charges of which will clear a stopped pipe, and an occasional charge keeps them clean, and also increases the make per ton and the illuminating power.

PRICE AND PARTICULARS ON APPLICATION.

Head Office: CORPORATION STREET, BIRMINGHAM.

"LIGHT, Wenham Gas Lamps MORE LIGHT."

ITS ADVANTAGES ARE:

IMMENSE ECONOMY IN THE CONSUMPTION OF GAS.

INTENSITY, PURITY, AND STEADINESS OF THE LIGHT.

Absence of Downward Shadow. *Practical Completeness of Combustion.*

CAN BE FITTED TO ORDINARY SUPPLY-PIPES WITHOUT ALTERATION.

CAN BE USED AS VENTILATING LIGHTS, whereby the products are removed, and damage to decorations, &c., prevented.

SOLE PROPRIETORS AND MANUFACTURERS: **THE WENHAM COMPANY, LIMITED,**

Birmingham Branch: 121, CORPORATION STREET. Works: UPPER OGLE ST., LONDON, W. Manchester Branch 5, DEANSGATE.

D. HULETT & CO., LTD.,

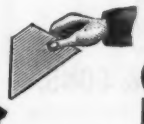
GAS ENGINEERS,

55 & 56, HIGH HOLBORN, LONDON,

Manufacturers of every description of Gas-Fittings.

HIGH-POWER LAMPS

Of every description, fitted with Copper Tops, Porcelain Cones, and Regulating High-Power Burners.



HULETT'S PATENT

STREET LAMPS.

No putty required.
Glass secured by hinged clips. No loose parts.
A new pane of glass can be fitted in a few minutes by any inexperienced person.
Glass can be supplied cut ready for use.
The frames are not liable to be damaged as in ordinary lamps when hacking out a broken pane of glass.
The glass can be removed for repainting.
Several thousands of these are now in use, giving general satisfaction.
They are strongly made, and of the best material.

HULETT'S IMPROVED

SERVICE CLEANSER

For Removal of Obstructions in Gas Service Pipes.

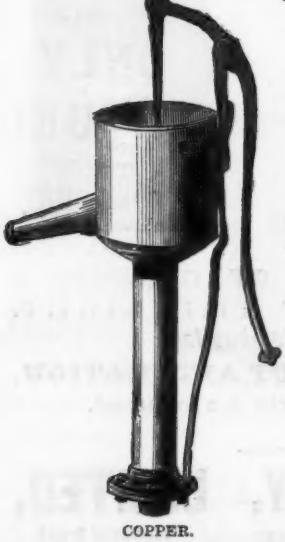
They are constructed with Air Vessels of great strength and capacity for storing a large quantity of air, which can be delivered at a pressure of 150 lbs. if necessary.

They are also fitted with Water Fittings, so that about a gallon of liquid can be discharged with the air, for removing Naphthalene from the interior of tubes.

WET AND DRY GAS-METERS

GAS PRESSURE GAUGES.

WROUGHT OR CAST IRON TUBES AND FITTINGS.



COPPER.

BRASS.

SYPHON PUMPS,

In Iron, Brass, and Copper.

IRON.

CAST-IRON SYPHONS FOR MAINS.

LAMP-POSTS.

CRADLES AND BRACKETS.

— PRICE LISTS UPON APPLICATION. —

JAMES D. PERKINS. F. SEAVERNS.

PERKINS & Co.,

228 & 229, PRODUCE EXCHANGE, NEW YORK.

Cable Address: "PERKINS, NEW YORK." *Post Office Box 3695, New York.*

SOLE AGENTS FOR THE CELEBRATED

BRECKENRIDGE CANNEL

AND THE

OLD KENTUCKY BOGHEAD

OF KENTUCKY, U.S.A.

These Cannels will rank with the Australian Shale for Gas Manufacture.

Also General Sales Agents for

PENNSYLVANIA & VIRGINIA GAS COALS, & AMERICAN FOUNDRY & FURNACE COKE.

Delivery Prices made to any Port in

GREAT BRITAIN, ON THE CONTINENT, OR SOUTH AMERICA.

Full Information furnished upon Application to the above Address.

CHEAP STEAM — FOR — GAS-WORKS.

MASON'S PATENT FURNACE

Can be applied to any kind of Boiler.

It improves the draught.

Economises time in raising steam.

Gives steam quickly at any pressure.

THE ONLY FUEL recommended is

COKE DUST, COAL DUST, CINDERS, SAWDUST, BREEZE,

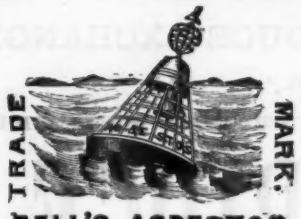
Or any other Refuse Fuel.

W. F. MASON,

ENGINEER and PATENTEE,

Longsight, MANCHESTER.

BELL'S ASBESTOS AQUOL PAINT



IS MADE READY FOR USE.

IS FIRE RESISTING.
IS WASHABLE.
IS NON-POISONOUS.
IS MANUFACTURED IN ALL USEFUL COLOURS.
IS IMPERVIOUS TO HEAT, COLD, OR WATER.
IS WITHOUT SMELL.

No expensive Oil or Turpentine required.

WILL NEVER BLISTER.

HAS A COVERING CAPACITY 40 PER CENT. GREATER THAN LEAD PAINTS.

For Outside or Inside Work in any Climate.

Bell's Asbestos Aquol Paint is equally suitable for the finest decorative work as well as for general painting. It can be applied over or under any other paint, and, owing to its easy application, can be used with a large distemper brush; the SAVING THUS EFFECTED IN LABOUR BEING **50** PER CENT. OVER THAT OF LEAD PAINTS.

Bell's Asbestos Aquol Paint is susceptible of the most delicate treatment; and, owing to its perfect flatted surface, it brings up the varnish in a manner that no other paint can equal. ONE COAT OF VARNISH ON **Bell's Asbestos Aquol** IS EQUAL TO TWO COATS ON ORDINARY PAINT.

BELL'S ASBESTOS AQUOL PAINT is specially adapted for Private Houses, Exhibition Buildings, Ships, Churches, Asylums, School Boards, Railway Stations, and all work of Wood, Iron, Cement, Plaster, Stone, Brick, &c., &c.

Those who Study Economy and Protection from Fire should use only

BELL'S ASBESTOS AQUOL PAINT.

BELL'S ASBESTOS AQUOL PRIMING is made Ready for Use.
BELL'S ASBESTOS AQUOL PRIMING stops all suction of Wood, Cement, Plaster, &c.
BELL'S ASBESTOS AQUOL PRIMING should be applied to all New Work.

Suitable for Ceilings, Walls, and New Wood, and is very durable.

BELL'S ASBESTOS AQUOL KNOTTING, for Stopping Knots in New Work.

AN EXCELLENT CURE FOR DAMP WALLS.

Colour Cards and Price Lists on Application.

Supplied in Casks of 5 to 7 cwt., and Iron Drums of 28, 56, and 112 lbs., Sample Tins of 7 and 14 lbs.

Owing to its Covering Capacity, a SAVING IN FREIGHT of 40 per cent. is effected for a given surface.

BELL'S ASBESTOS COMPANY, LIMITED,

SOUTHWARK, LONDON, S.E.

DEPOTS—MANCHESTER: Cable Street, Blackfriars. **LIVERPOOL:** 2, Strand Street, James Street. **HULL:** Humber Dock Basin. **GLASGOW:** 35, Robertson Street. **DUBLIN:** 2, St. Andrew Street. **BERLIN, BARCELONA, and ANTWERP.**
AGENTS—BIRMINGHAM: BELL and Co., 7, John Bright Street. **BRISTOL:** ROBERT STOTESBURY, 114, Redcliff Street. **CARDIFF:** BELL and Co., West Bute Street.

BELL'S ASBESTOS

EXPANSION SHEETING.

The above, which can only be obtained from this house, is recognized as the **most efficient and economical jointing material in use.** It is composed of a specially-prepared India-rubber Compound, protected by a covering of Vulcanized Asbestos Sheeting, as shown above; and as it is the only Jointing Material which adequately **combines permanent elasticity with heat resistance,** the advantage it possesses will at once be seen.

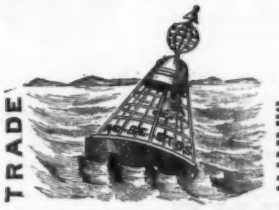
EXPANSION RING.

The centre from which the requisite elasticity is obtained will adapt itself to uneven surfaces to which it may be applied, and allow the expansion and contraction to be fully taken up. The covering being of Asbestos Cloth imparts a protection to the centre, and so prolongs its elasticity. **For Manhole, Mudhole, Steam Pipe, and Mash Tun Door Joints, it is unequalled;** and if applied as directed, **a ring can be used many times over.**

Made from 1-Ply for Cylinder and Faced Joints to any thickness for Uneven Surfaces.

BELL'S ASBESTOS CO., Ld.

DEPÔTS.
MANCHESTER: Cable St., Blackfriars.
LIVERPOOL: 2, Strand St., James St.
HULL: Humber Dock Basin.
GLASGOW: 35, Robertson Street.
DUBLIN, BERLIN.



DEPÔTS.
BARCELONA, and ANTWERP.

AGENTS.
BIRMINGHAM: BELL and Co., 7, John Bright Street.
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Southwark, London, S.E.

BELL'S ASBESTOS
YARN AND SOAPSTONE PACKING
BEST LOCOMOTIVE PACKING made.

BELL'S
COMPOUND HYDRAULIC PACKING
Is specially suited for Hydraulic Machinery, Accumulators and Ammonia and all Pumps.

BELL'S ASBESTOS LUBRICANT
Is unequalled
For Steam-Engines & Cylinders, Gas-Engines, and every class of machinery.

BELL'S ASBESTOLINE
The reputation of this Lubricant is based on the experience of thousands of users, which places it far in advance of those who rely only on mere laboratory tests.

ASBESTOLINE IS THE CHEAPEST MOST EFFICIENT, CLEANEST MOST INODOROUS AND SAFEST LUBRICANT.

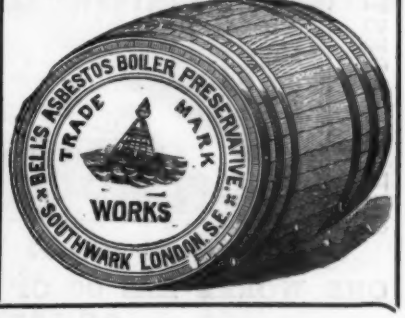
ASBESTOLINE HAS SAVED 90 PER CENT. OVER OIL.
Has been used for all purposes, AND BEATEN ALL OTHER LUBRICANTS IN ACTUAL WORK.

BELL'S ASBESTOS
"DAGGER" PACKING
Is unequalled for every kind of Marine and Land Engine, Steam-Pumps, &c., and has proved itself to be the most efficient durable, and economical Packing made.

BELL'S ASBESTOS
NON-CONDUCTING COMPOSITION.

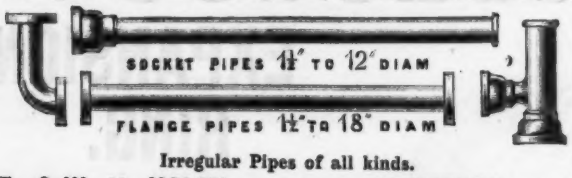
Will reduce loss by radiation and saves 40 per cent. of fuel.
Is superior to any other, and saves its cost in a few months.
Can be applied when steam is on. Is sent out dry in bags, therefore keeps sound for years.
ALL BAGS ARE MARKED AS ABOVE.

BELL'S ASBESTOS
BOILER PRESERVATIVE
Will effectually keep Boilers clean, and remove any Incrustation, without injury to the Boiler, Plates, or Fittings.



CAST-IRON PIPES.

Castings of all kinds for Engineers, Gas and Water Works, &c.



Irregular Pipes of all kinds.

E. & W. H. HALEY, IRONFOUNDERS, BRADFORD, YORKS.

HORSELEY COMPANY, LTD.

TIPTON, STAFFORDSHIRE.

London Office: 6, Westminster Chambers, Victoria Street.

GAS ENGINEERS, IRONFOUNDERS, &c.,

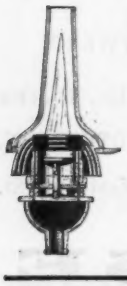
MANUFACTURERS OF

GASHOLDERS,

AND ALL KINDS OF GAS AND WATER WORKS PLANT.

THE NEW "DOUGLASS"
PATENT GAS-BURNERS

(SIR JAS. N. DOUGLASS'S PATENTS).



Burners upon the "Douglass" principle are now on the market for ordinary purposes as used by the Government and at the following Lighthouses: The Eddystone; Dungeness; Whitby; Scilly Rock; and many others.

GIVE A PURE WHITE AND BRILLIANT FLAME.
Without Smoke or Chimney Breakage.

CONSUME LESS GAS, and give a more **POWERFUL LIGHT** than any other Burner yet devised.

SIZES FROM 15 TO 3000 CANDLE POWER.

All particulars can be obtained from

F. H. VIGNE,

Agent for the "DOUGLASS" Gas & Oil Burners,

57, Chancery Lane, W.C.

JONAS DRAKE & SON,

—GAS— —ENGINEERS— —CONTRACTORS— —IRONFOUNDERS— —RETORT SETTERS— —ETC.—

Specialities in CARBONIZING PLANT.

GENERATOR AND REGENERATOR FURNACES.

OVENDEN,

HALIFAX (YORKS.)

Gas-Bags for Mains. **High-Water Boots.** **Woollen Miners' Jackets.**

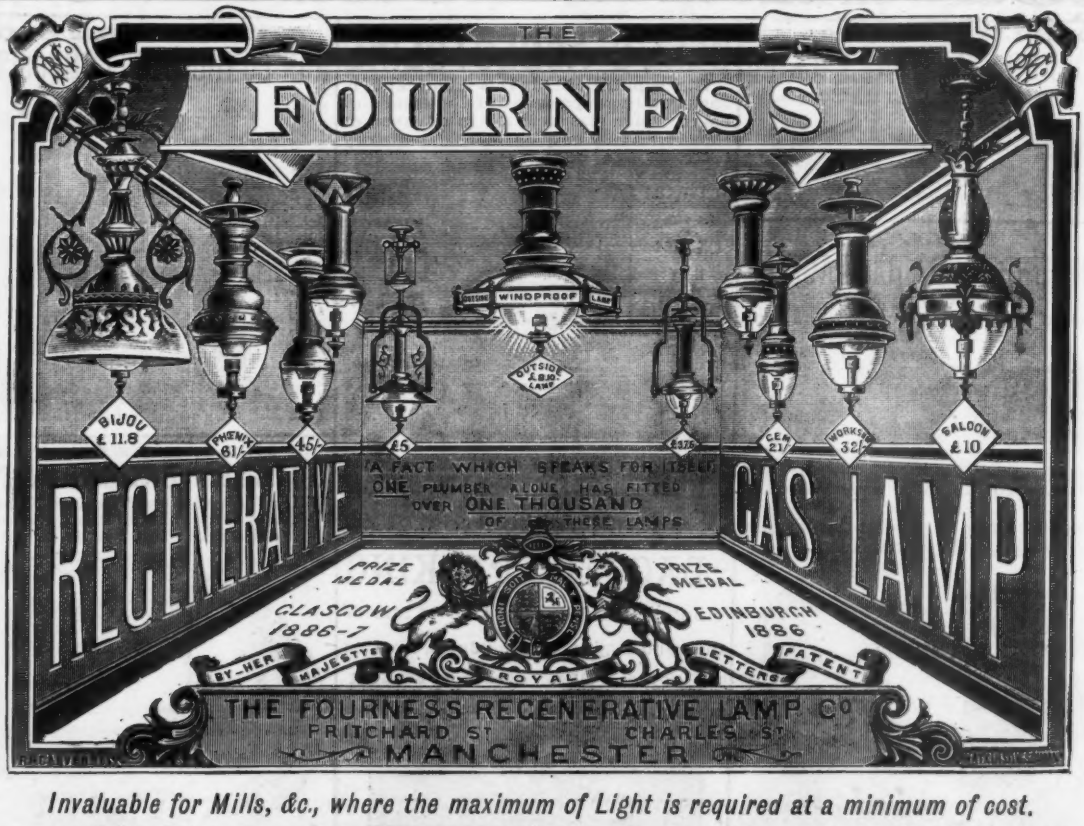
Delivery and Suction Hose, Gutta-Percha Acid Bottles, Leather Driving Bands, Woven Canvas Hose for Fire-Engines, Wedge and Square Gas-Bags, Air and Water Beds for Invalids, Oil Tarpauling Coats, Trousers, Hats, &c., Squeegees for cleansing Pavements, &c., Billiard and Bagatelle Cush, Tricycle Tyres, Leather Hose, Cotton Waste, Engine Cloths, Oils, &c., India-rubber Waterproof Garments for Walking, Driving, or Sporting Wear, Diving and Wading Dresses, Printers' Blankets, Iron Wheels and Rollers covered with India-rubber, and Stokers' Gloves.

Write for Price List to

THOMAS BUGDEN, Manufacturer,

116 & 118, GOSWELL ROAD, LONDON, E.C.

THE CHEAPEST AND BEST LAMP IN THE MARKET.



Suitable for every place where Gaslight is required.

Invaluable for Mills, &c., where the maximum of Light is required at a minimum of cost.

ONE WORKS HAS 96 OF THESE LAMPS FIXED AND GIVING SATISFACTION.

AGENTS WANTED IN EVERY TOWN.

PREPAYMENT GAS-METER.

(PRICE'S PATENT).

This Meter has a simple Automatic arrangement fitted, whereby, upon the insertion of a shilling, a supply of gas can be obtained, and which is cut off on the quantity paid for being consumed. The Meter gives warning when the quantity is nearly exhausted, so that another shilling may be inserted. There is, however, no occasion to wait until this happens, as a second shilling can be inserted after two-pennyworth of the first shilling has been consumed.

The Meter is fitted with the ordinary registering dial, and has in addition a circular one divided showing twelve pence. On each Meter is marked the number of cubic feet it will pass for one shilling; and this can be arranged to cover cost of Meter-Rental, Fitting, and Gas consumed. These Meters are made of the best material and workmanship.

SPECIALLY ADAPTED FOR INCREASING CONSUMPTION AMONGST SMALL CONSUMERS.
NO RISK OF BAD DEBTS.

PROPRIETORS AND MANUFACTURERS:

D. HULETT & Co., LIMITED,

GAS-METER MAKERS, 55 & 56, HIGH HOLBORN, LONDON.

Two Thousand Boilers kept Clean

By using "CROSBIE'S COMPOSITION," which is absolutely harmless, and the most economical means of preventing Incrustation obtainable. Testimonials on application. Price in casks, 18s. 6d. per cwt., delivered free. Used at the following Gas-Works: Ascot, Birmingham, Broadstairs, Bromsgrove, Hendon, Leven, N.B., Pembroke, Seaham Harbour, Stamford, Warwick, &c., &c., and by leading Engineers throughout the Country.

ADOLPHE CROSBIE, Walsall Street Chemical Works,
WOLVERHAMPTON.

GEORGE ORME & Co., Atlas Meter Works, OLDHAM.

Manufacturers of

IMPROVED WET AND DRY GAS-METERS, in Cast-Iron and Tin-Plate Cases.

LAMP METERS.

PRESSURE GAUGES.

IMPROVED STREET LANTERNS of New Designs.

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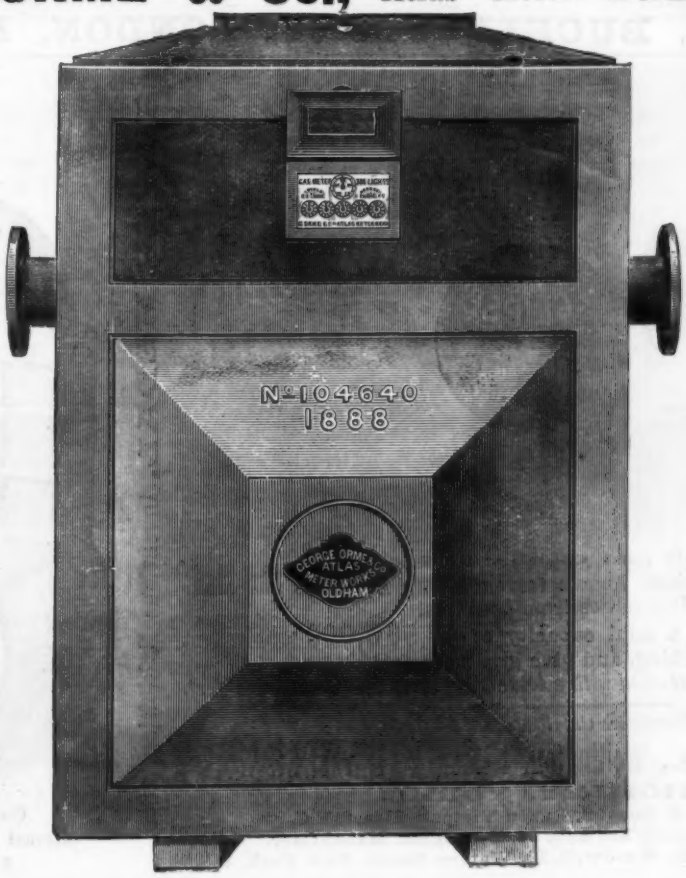

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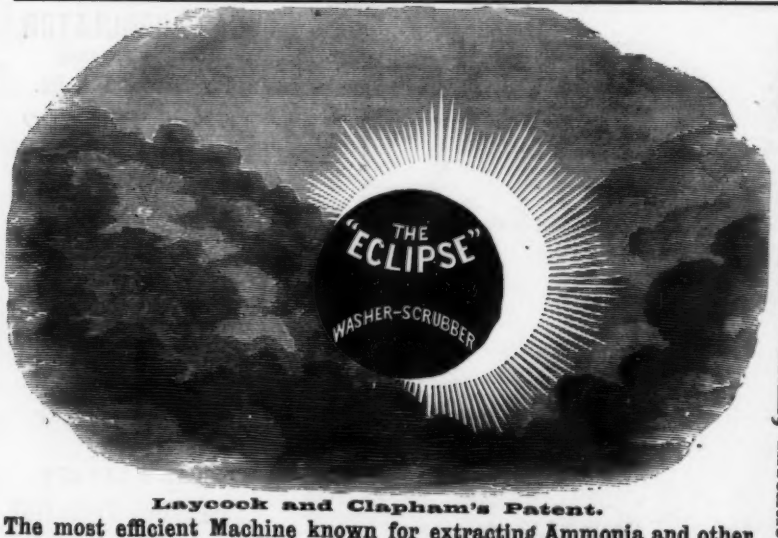

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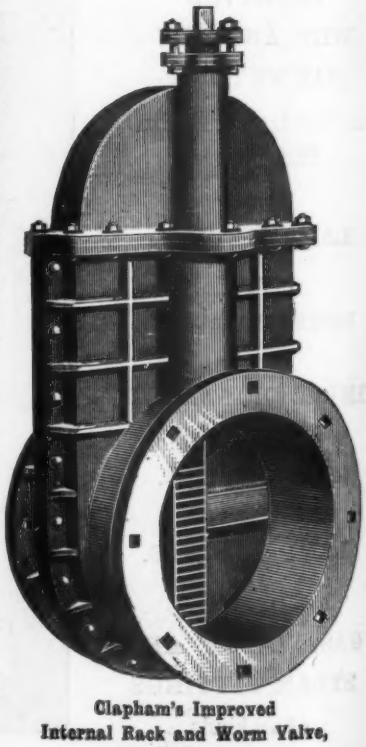

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